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THE

JOURNAL OF SCIENCE.

JULY, 1882.

I. VEGETABLE SOIL.*

By G. H. KINAHAN, M.R.I.A., &c.

(Concluded from page 341.)

Stones on the Surface of the Ground.

DR. DARWIN seems to be of the opinion that the burying of surface stones is principally due to their being undermined and lowered by worms burrrowing under them: this, however, does not appear to be proven. In my previous publications I have given facts which show that vegetable growth and decay, as also ant-work, are efficient workers; not, however, as lowerers of the stones, but as builders up of earth around them. Surface stones are natural equalisers of the temperature, keeping the ground near them cool in summer and warm in winter, some stones being better conductors of heat than others; therefore immediately around them there is more vegetable growth and decay than elsewhere in the same field, as will be seen in innumerable places in the stony portion of Connaught and Munster. This vegetable growth and decay, especially if the stone stands a foot or more over the surface of the ground, is greatest opposite the sun at 11 o'clock a.m.; and if the stone is on a flat surface, and the increase of the soil is *solely due* to vegetable growth and decay, the earth will increase fastest to the S.S.E. of the stone. These results, however, are nearly always modified, as rain and rivulets may carry matter and lodge it at other sides of the stone, or winds will carry dust and make accumulations. The prevailing wind of a district is a great auxiliary in burying a

* This paper was written prior to the death of the eminent philosopher, Dr. Darwin, and was ready for the press when his lamentable death was announced, which consequently delayed its publication.

stone, as nearly daily it carries a few particles of dust and lodges them in the growing plants, thus promoting their growth. Some ants also always patronise these stones, beginning their work at the sunny side, from which they rapidly carry their accumulations on to it; while worms ought to work most to the north or damp side, which often is the last to be covered, or is left uncovered.

In Ireland there are numerous megalithic structures, and with excavations about such I have at different times been connected. In Glenbonniff, near Feable, Co. Clare, there are *fosleacs*, or flag dwellings, one of which was excavated by my brother, the late Dr. J. R. Kinahan, over thirty-five years ago. When he began it was completely covered over by vegetable matter (peat), and stood intact as when first erected on the old surface of the ground. I have since again visited this place, and since he was there other similar structures, similarly circumstanced, have been exposed by the turf-cutters. These structures were solely buried by vegetable growth and decay.

In Ballykean, near Redcross, Co. Wicklow, there are a number of "cupped stones," some still standing well out of the ground, while others are nearly buried. To try and find out what was the original use of the cups, or at what time the cups were made, I excavated about some of them. Those that were more deeply buried (some were then nearly covered up, although all were to be plainly seen at my first visit four years before) had about 18 inches of vegetable soil alongside, which was far in excess of the average depth on the rest of the field (about 8 inches), but all rested directly on a shingly substratum, the same as the subsoil under the rest of the field, into which, in no case, had they sank, although in some cases it was evident that when the land was first tilled (it had been a wood 200 or 300 years ago) holes alongside the large stones had been dug, and the smaller stones buried in them. Similarly with all the megalithic structures that elsewhere I have excavated about, they rested on the natural subsoil similar to that under the vegetable soil of the adjoining ground. In the case of the Ballykean cupped stones I believe the great growth of soil, in the four years previous to the time the excavations were made, was principally due to the grass during the last two years not having been cut for hay, but having been left as winterage for cattle.

In many of the prehistoric feartha, or burial-places, the kistveans were at or near the surface of the ground, and at the present time they nearly invariably are at or near the

surface of the ground. In Ireland the prehistoric people usually made the kistvean about 2 feet square and from 12 to 15 inches high, the sole stone of the kistvean being on the subsoil, or slightly below its surface. Thus the structure originally was more or less above the surface; but now, although above the surface of the adjoining ground, the kistveans are usually covered with soil which have evidently grown up and covered them,—often the work of ants, at other times nearly solely due to vegetable growth and decay. In this class of feartha the dead were burned, and their ashes placed in the kistveans either with or without urns, so that there were no great inducements for worms to congregate at such places; but there are other feartha, like that at Mervinstown, near Dunlavin, Co. Wicklow, where unburned bodies were buried in the kistveans, which must have been an inducement for the worms to congregate and burrow below in the adjoining soil; yet in no place were the stones displaced and put out of gear by the worms burrowing under them. There are other prehistoric graves to be found on the west coast where the corpses were enveloped in sea shells. Sections of such graves may be seen in places where a stream or the sea—as at Ballinskellig, Co. Kerry—has cut away a portion of the graveyard; but in no place that I have seen was *the original bottom* of the grave disturbed, the growth of soil above the grave having no connection with the removal of the soil or clay alongside or below it.

While geologising the West Galway hills I had occasion, during the autumn of 1872, to walk along the grassy Silurian slopes between Maumturk and Leenaun, and my companion, as we went along, amused himself by rolling down the slopes the different surface stones: this was not, however, altogether useless work, as we wanted to learn the origin of certain accumulations of blocks in the bottom of the valleys. Some of the stones he could easily set rolling, while others I had to assist him with, which led me to observe that all the more or less buried stones had new or old ant-works alongside, while those that lay nearly on the surface had only worms and beetles under them. I should mention that these stones were stones that in the winter had been loosened by frost or other weathering from the cliffs above, and had lodged on their way down. As it is the general practice with the shepherds to set all the lodged stones "a rolling," in the spring, to "clear the grass," most of the stones we met with had not been there six months; but some, that had the old ant-hills alongside, must have been there from the year before. Such observations, then first made, have since made

me, in many other localities, to turn over the surface stones to see what buried them, and nearly invariably my general conclusions have been that it was mostly due to vegetable growth and decay, except in an ant country.

In May, 1881, I had occasion to visit the great Saltee, off the South coast of Wexford, and in one cliff numerous birds were nesting. As I wanted to know what kinds of birds were there, I got my companion to go and roll down stones over the cliff. He had never previously seen so many birds congregated together, and when I joined him he asked me if I would roll down some stones that he might see the flight. While he was going round to the opposite side of the coose, I employed myself raising stones to roll down, which I found very difficult to do, as all were nearly entirely buried in a sort of peaty soil. This I could not at first account for, as there was no ant-work,—nor a worm to be seen,—while the peat was of a class evidently not solely due to vegetable growth and decay. After carefully examining the place the only conclusion I could arrive at was, that, during the prevalent winds from the S.W., the *débris* of the peat and of the granite was blown from a neighbouring gap and lodged here; it subsequently being consolidated by vegetable growth.

The Irish ants have distinct peculiarities. One species affect moist low ground, on which they build high pinnacles, keeping to the same place year after year; others keep to the stiff upland, where they work very similarly; while another kind keep to the wild land, where they make large flattish hills; but those with which we are now interested always plant their colony at a surface stone. Of the latter the first colonists seem to take up their abode under the stone, and make innumerable galleries and cells to lay their eggs in: this is generally in April and May, but this year (1882) I found them working in the latter end of February. As the weather gets warm they extend their work to the outside, and gradually creep up on it. The stone appears to be used as a generator of heat, or, perhaps more correctly, as an equaliser of heat (stones on the surface of the grass promoting heat in winter and cool in summer), because when a stone is entirely, or nearly entirely covered, the ants will leave it. Some of the ants are extraordinary workers. In parts of Clare and Galway the crags of mountain limestone are perfectly bare; yet I have seen a colony of ants take a fancy to a stone lying on one of them, and build an ant-hill against it. Where they got the materials to build the hill it is hard to say, unless they travelled all about the surface of

the crag and picked off its surface the minute disintegrated particles. In such cases it is evidently a building-up process which buries the stones. This is quite an exceptional case, as you might travel these crags for weeks before you met such an ant-hill. In fact at the present moment I can only remember one locality in which I saw them, and that was in Glencolombkill barony of Burren, Co. Clare, but I think I also saw them elsewhere.

Worms leave a stone that ants come to, but after the ants have left it you will find worms in the old ant-soil, and their castings on the old ant-hills. Worms seem to have an antipathy to ants. I have over and over again put them travelling towards an ant-hill, and in a few cases they have gone straight on into it, but in general they appear to smell the ants, and suddenly will begin to travel backward, and get away as quickly as possible. If he goes into the ant-hill he is stung to death nearly immediately.

In May, 1881, a flat stone, 2 feet long by 10 inches wide, and nearly 3 inches thick, was put on the surface over a dog's grave in a rhododendra shrubbery; the grass was cut about July, but the after grass was let rot; and in January (1882) the stone was nearly covered, there not being a trace of worm-work alongside or over it, while under it were two worms and some beetles. I expected that, as the dead grass around and over it formed into mould, the worms would appear, but when I again examined it in the beginning of March I could not see a trace of one, and on raising the stone I found a colony of ants there, which evidently had hunted away the worms.

In Ireland, as a general rule, if you unstone or clear land (that is, take the large surface blocks off it), let the land be mountain slopes or lowland, you find most or all of the erratics resting on the subsoil, and buried more or less in vegetable soil. From this it would appear to me that the stones could not possibly have sunk, but that the soil must have grown up around them. Most of this stony land was cleared of its woods between 200 and 300 years ago; some, however, at a later date. The usual character of these tracts of stony ground, before they are reclaimed, is a mossy or heathery waste,—or a rushy or swampy tract, in which ants may work, but no worms, except in very isolated spots; but after they are stoned, drained, tilled, and eventually laid down in grass, they are as much frequented by worms as any other grass land. I reclaimed, thirty years ago, about 30 acres that were in part a swamp and in part a heathy waste, and now it is in grass land and full of worms, which could not live in it formerly.

Buried Antiquities.

In Chapter IV. of "Vegetable Mould and Earth Worms" the author intimates that the antiquarian is often indebted to worm-work for the preservation of antiquities, and he brings forward prominently the curvature of the floor of buried buildings and the curvature of the surface of the ground over buried ruins in support of the case. But might not these things happen without the aid of worm-work?

Let us first consider the iron arrow-heads he mentions as found in surprising numbers on the northern side of the Severn, not far from Shrewsbury. These arrow-heads apparently were originally dropped on the surface of the ground; and if the worms worked their best, and the years were the most favourable for worm-work, the worms could not have covered them up in two or three years, or more, during which time many of them would have decayed away. But if a battle was fought on the place, and especially if much blood was spilled, the vegetation afterwards would have been most luxurious, and during the succeeding summer it would have taken a cute observer to detect an arrow-head without digging up the ground. These arrow-heads "were found at the bottom of the furrow,"—that is, at one regular depth below the surface; vegetable growth and decay would bury them at one regular depth, which worm-work could rarely do. A few years ago, near Donnybrook, Co. Dublin, the burial-place of a Norse Viking chieftain was discovered, which has been described by Dr. W. Fraser, F.R.C.S.I., in the "Proceedings of the Royal Irish Academy," 2nd ser., vol. ii. (Pol. Lit. and Antiq.), p. 29. I assisted him one day during his excavations, and from my observations, and those published by him, these prehistoric remains were all on one regular surface, over which the soil had since grown. When I was there a large surface of the mould had been cleared away, leaving an even surface above which no remains were found, all being immediately under it. Some of the remains had originally been left on the surface of the ground, such as "fire-heaps" and heaps of human heads, while some of the bodies had been buried in rude trenches; and the buried trenches, the "fire-heaps," and the heaps of human heads had not been disturbed since they were first made or placed, the mould evidently having grown over them, and not having been brought up from under them. Similarly, in other places where I have made explorations, I have found that antiquities lie on regular old surfaces,

which your workmen soon learn to recognise and keep to, and are rather disgusted when you make them hole it in places, to see that they are not leaving anything of interest behind them.

Lime or ashes, originally laid on the surface of the ground, as mentioned by Darwin, are found buried in layers. This subject I treated on in my former writings, and pointed out that if worms covered them by mould brought up from under them, the layers must have become distorted and uneven Now I would mention a somewhat allied case that lately came under my observation.

As I have pointed out in my little book on the "Reclamation of Waste Lands in Ireland," "beatin"—that is, burnt sods or vegetable mould—was formerly extensively used by the poorer farmers in Ireland until stopped by Acts of Parliament passed in the reigns of George II. and George III. Whilst traversing the hilly country westward of Shillalagh, Co. Wicklow, I came on about a quarter of an acre of land with rows of heaps on it, which, on picking into, I found to be heaps of beatin covered with a coat of from 3 to 4 inches in depth of vegetable mould. It was evident that many years ago the patch was "scrawed," and the scraws or sods, after they were dried, had been collected in rows of heaps and burned into beatin; but for some reason the reclamation was then stopped, and the heaps of beatin left unspread. The heaps are still intact, except that coats of mould have grown over them, and this could not have been brought up by worms from underneath. There were no traces of worm-work in the land about them, which was mossy and heathery; neither could I see any on them; but it was rather late for worm-work (the end of April), and possibly it would be seen if they were visited in the winter.

Curvature of Floors and Surfaces over Old Buildings.

In the spaces between the walls of any building, without worm-work, the ground away from the walls must shrink more than that in contact with them. Passages in houses are usually paved, or tiled, or flagged. If paved, the centre nearly invariably is much higher than the side, while if it is tiled they are laid even; in either case you put under the stones or the tiles materials that worms cannot burrow in, yet, although the foundation has been made as compact as possible, after a time the centre of the passage will sink: if you flag the passage, and all your flags do not extend the full way across, after a time the short flags will sag downwards

toward the centre, and will have to be reset. Floors of rooms paved, tiled, or flagged will curve more rapidly, the flags often breaking up. The first office I was in, was that of an engineer and architect, and part of his business was looking after house property in Dublin, a duty I was often employed on. I was ordered to go and examine a first-class house in Upper Mount Street, occupied by a Col. R.E. It was not a hundred years old, as it had been built after the year 1798, yet the kitchen floor, which was flagged, had sagged at the centre over 6 inches. I found that originally the flags had been most carefully set on about 9 inches in depth of rubble, over which was a coat of mortar: no worms could have worked here. In stables the centre of the stall will nearly invariably go down, and under the pavement you will find gravel more or less impregnated with the ejecta of the cattle, which alone would prevent worm-working under the stones.

In 1850 and subsequent years many of the Irish callows and other flooded flats were drained. Some of them, such as those near Strokestown, Co. Roscommon, were level before they were drained, but after the water was taken from them they began to contract and show irregularities, the walls of crannogs standing up, while the surface inside them sagged down. No worms could have worked here till after the water was gone. It may be said that this is an exceptional case, but still I believe it has a bearing on the subject, because in a confined space, such as a room between old walls, the contraction must be greater away from the walls than in contact with them. In a letter from Mr. Lee, of Caerleon, written some ten years ago, he mentions that Roman remains in his neighbourhood were discovered during a very dry summer by ridges forming on the surface of the ground, the contraction over the walls being less than in the spaces between them, although the walls were from 5 to 6 feet from the surface.—("Valleys and their Relations to Faults, &c.," Appendix, p. 234.)

If a number of worms excavated under a wall, of course it must go down; but would it go down evenly and regularly? and what would the worms go there for? Except at such times as the worms go down deep to hybernate, during dry warm or cold weather, they appear only to tunnel in search of food, which rarely they would find under the foundation of a wall; and I suspect, if any of these old Roman walls were cleared out, their foundations would be found to lie on the regular floors on which they were originally placed. At least such has been my experience

in connection with the walls of the prehistoric structures in Ireland.

As yet I have seen nothing that will explain the exceptional deep burrowing of worms, also where they come from. Often in deep soils, apparently favourable for worm-work, you will not find a worm or the trace of a worm; while at other times, at great depths, you will find them in stuff that you would think they would not burrow in. Bury vegetable or animal matter, and as a general rule it will breed worms, but sometimes it will not. Bury horse stable manure, the horses having been fed on hard dry food, and until it is perfectly rotten there will be no worms in it; while bury cow-house manure, even under clay well tamped down, and in a short time it will be full of worms, while not a trace of them can be seen on the surface of the ground. Brandlings are a peculiar worm thought much of by fishermen: I am not a fisherman, but some of my youngsters are, and they have colonies of brandlings in heaps of manure, out of which they do not seem to stir. (Note, p. 387). These worms do not appear to be generally distributed, yet in the spring of the year, if you go into old turnip land, or the like, and dig under the heaps of turnip-tops or weeds, you are sure to get some. Where do they come from, because at other times they will not be found?

Put in a trench layers of cow-manure, and layers of clay or rubbish, such as broken up old lime or ashes, and after a time in the manure you will find lots of worms, but none in the intervening layers. Similarly, in excavations in old ruins, if you find worms they are in the layers of decayed vegetable or animal matter, and not in the other stuffs. But often, even in the favourable matter, none may be found when it is first dug into; you may be digging for a day, and only one or two be turned out, they being so rare that the workmen always remark any that are found. I have also seen some of these explorers got at great depths in callow land, greatly to the astonishment of the men, who cut them up into little bits suspecting them to be a "paisteens," or something else "not right." Some worms go to great depths, which must be allowed by all who have studied them; yet these deep explorers are so few and rare that what work they could do would not be appreciable in millions of years.

Although it has been already mentioned, I may again refer to the worms found in excavations *after they are opened*, as Mr. Ferrer's notes, quoted by Mr. Darwin, seem to confirm my observations, the number of worm casts in his excavations appearing in conformity with the changes of the

weather, they being few when it was dry and not favourable for the worms to travel, and numerous when it was damp or after rain. New mortar worms abhor; dry mortar rubbish, such as you get if you pull down an old house, they do not appear to care for; but rotten mortar, such as you get in buried ancient structures, they delight in. This appears due to the chemical changes that have taken place. I knew a gentleman in the county of Longford whose house was next the old ruin of a mill, which he pulled down, and on its site, in the old mortar rubbish, he planted a strawberry bed: this bed for some years would not breed a worm or slug, but after a time, when it had rotted, they came there as elsewhere. The mortar rubbish has part of the sting of the lime left in it; but the rotten mortar in prehistoric structures is now a lime soil, besides being more or less impregnated with vegetable or animal matter imbibed from the rubbish that has filled in and buried the ruin; the worms therefore, as soon as they can get at it, burrow into it, let it be in the perpendicular walls or in the floor. This, however, is not the case always, as in some of these old mortars, before they are opened up to atmospheric influences, I suspect the worms could not burrow, because in such cases I have observed that the freshly uncovered mortar is perfectly hard until it has been exposed to the air for a few days, when it disintegrates and becomes quite friable.

Worms are wonderful workers, but, as I have already said, I cannot believe that—except rarely—they work below the vegetable mould, and therefore they cannot increase the soil in depth. Their great use appears to be in old grass land, where they bring up the mould from among the roots of the plants and top-dress them with it, because, as I pointed out years ago, if you break up grass land *you will find the old tillage floor intact, although it may have been buried for years*. The ploughmen of Wexford and Wicklow will show you the floor that their fathers, grandfathers, and great-grandfathers tilled on, and a man who would break through this floor and bring up the "yallar" ground (clay), or subsoil, is considered a bad ploughman. They all have a firm belief that if they bring up the "yallar," or go into the gravel, they spoil the land; this, however, is not a question to be discussed here.

In conclusion I would refer to some deepeners of the soil whose work I have not seen elsewhere recorded, and these are the large copper-coloured and blue beetles called respectively "cockchaffers" and "bumbly bees." The last I have observed this spring in great numbers on the wild hill-slopes

of Wicklow, Carlow, and Wexford, they burrowing down into the yellow clay subsoil, and bringing up little heaps about 3 or 4 inches in height and diameter: very interesting work of theirs occurs in connection with cow-dropping, as when three or four burrow under one they bring up enough clay to cover it up, which in a very short time forms a turf of sweet grass. To them therefore, in part, is due patches of good grass in mountain wastes, especially in any sort of sheltered place, as here the cattle at times will herd, while subsequently their ejecta will be covered up by these beetles, thus fertilising the patch: without the beetle-work the ejecta would probably be dried up by the sun, and carried away by the wind, rain, or runlets.

NOTE to page 340.—Some worms are not so careless. On May 23rd, 1882, during the first day of rain after a long drought, I was watching, out of a house in a shrubbery, worms travelling. They were taking their time, elongated to their full extent and scarcely contracting themselves at all, so that they got along very slowly. One came into the house, and when he got on the dry boards he did not seem to like it at all, and raised about an inch in length of his body, with which he felt about for some time; he then went on slowly, but straight: after the first board there was a hole, into which he did not tumble, as he kept half his body up above, while the other half he bent down at a right angle and elongated it to an extraordinary extent, by which means he was able to touch a dead leaf at the bottom, to which he clung, and then gently drew down the rest of his body.

I have also observed that worms coming out of a hole in the side of a perpendicular trench will try to crawl up or down it; sometimes they succeed in getting up, especially if they can so elongate their body that the end of the tail remains in the hole while the point of the head is on the surface of the ground; generally, however, they tumble down to the bottom of the trench.

NOTE to page 385.—During the drought in May the heap got too dry for the brambles, and some of them migrated,—a portion to a large heap of rotten dung in a lane south of the original place, and others to a much dunged border of rhubarb east of the first locality. It is extraordinary how fast they increased in each of these places.

II. THE WAR AGAINST AGRICULTURE.

By An Old Technologist.

I AM about to discuss a startling, and, from a British point of view, a decidedly unwelcome subject,—the attempts now being made to substitute artificial manufactured articles for the produce of the fields, the plantations, and the woodlands. I will at once admit that the title I have chosen is open to objections, since the movement which I am to describe aims in some cases at superseding tropical or sub-tropical products by matters the growth of cold climates. But if I had said "War against Tropical Agriculture" I should have fallen into another error, since one of the principal victims to the movement in question has been an important crop, which but a few years ago was widely grown in France and Holland. However, in these days the title of a book or a treatise is not always designed to throw any very clear light upon its subject, as witness Mr. Ruskin's "Sheepfolds." What I am intending to describe will appear clearly enough below.

The vegetable and animal products which man obtains by agriculture and horticulture arrange themselves into two fairly natural classes. There are, on the one hand, substances which we value for the sake of some one principle which they contain, and which we are generally able to extract and use in a separate condition. This is the case with the bulk of medicinal drugs, dye-wares, condiments, and perfumes. Thus we value opium substantially for the morphia which it contains, Peruvian bark for its quinine and analogous alkaloids, the sugar-cane for its sugar, madder-root for its alizarine, logwood for its hæmatoxyline, the nut of the Elais palm for its oil, &c. Human ingenuity has long ago sought to obtain these valuable and active principles in a state of purity, which, as they are so-called "chemical individuals," has generally proved successful.

With the second class of bodies—such as the grains of wheat or barley, the fruits of the pear-tree or the vine, the milk of the cow, or the flesh of the ox and the sheep—the case is quite different. Here there is no one principle upon which the value of the product depends. There are in such substances a number of chemical compounds, mixed not indeed mechanically, in the usual sense of the word, but

physiologically. Let us take the instance of milk: here we have milk-fat, milk-sugar, caseine, albumen, and nucleine, besides galactine, lactochrome, certain mineral salts, and a number of minor ingredients. These various substances, though they are chemical compounds, are not combined together chemically, but exist in a mixture. The physiological action of the milk, as food, depends not upon any one principle which might be extracted and consumed separately, but upon the whole in their ordinary proportions, upon their modifying action upon each other, upon their physiological condition, and their structure.

We might in the same manner examine a grain of wheat, an apple, or a mutton-chop, and find that its value as food depends not on its chemical individuality, but on the joint presence of a number of substances which must be in certain conditions. Thus suppose we were to undertake a comparative analysis of two beef-steaks, the one tender and the other tough, we should doubtless find their composition substantially one and the same. Yet if a man eats the tough steak he will suffer more or less from indigestion, whilst from the tender steak he would experience no unpleasant consequences.

If we turn from articles of food to textile fibres, such as flax, hemp, or cotton, we shall find that though consisting essentially of one and the same chemical principle, cellulose, yet when freed from all foreign matter they still exhibit differences of properties which fit them for different uses, and which depend not on chemical distinctions, but on structure.

If we now compare these two great classes of natural organic products, we find certain very important practical distinctions. Class I., the dyes, medicines, perfumes, &c., are generally much more profitable to the farmer and planter than Class II., the foods, fibres, &c. Again, Class I. is mainly produced in tropical or subtropical climates, whilst Class II. may be raised even in temperate and subarctic regions.

A more important distinction follows: the bodies we have included under Class I., being definite chemical compounds, their artificial production is at least conceivable. Suppose we obtain, through the vital action of a plant, a combination of oxygen, hydrogen, carbon, and nitrogen, in certain proportions: we may possibly get the same elements to combine together in the same proportions without the intervention of the plant, or, in other words, to make the compound in question artificially. In other cases we may obtain the same, or a closely analogous product, through the instrumentality

of some other plant. Whether such artificial preparation is possible may depend upon the skill and the perseverance of those who take it in hand, and upon the degree in which the resources of chemical science have been developed. Whether the artificial drug, or other compound, can compete with or supersede the natural product, is a purely commercial question turning upon the cost of the process, but it is unfortunately in many cases complicated by fiscal regulations.

With bodies of the second class the question of artificial production is scarcely conceivable, much less has it been hitherto solved. Let us take the case of milk: the milk-fat, which when separated out is known as butter, is an exceedingly complex body, a mixture—not a compound—of the glycerides of palmitic, stearic, oleïc, butyric, caproïc, caprylic, capric, and rutic acids. We have then the albumenoid bodies, the milk-sugar, and the mineral matters. Now if we suppose that each of the organic compounds just mentioned had been artificially produced,—and this is not the case with even one of them,—we should still be at a loss how to blend them together as they are in Nature, how to give them the correct physical condition, and how to introduce the phosphates of lime and soda, the chloride of potassium, and other mineral salts which are found in natural milk, and which, though but small in quantity, are indispensable in the nourishment of the young animal.

Or take the case of a joint of meat: suppose we could artificially produce the albumen, the fibrine, the gelatinous matter, the fats, &c., our task would be only beginning. If we present the fibrine in dense masses, instead of in the fibrous state from which it derives its name, and in which it always appears in the flesh of animals, we should have a very indigestible matter to deal with. And how to make it assume this fibrous structure without the aid of the processes present in the living animal is a question of a totally different order, from its mere synthesis as a chemical compound.

So, again, with cotton. Cotton, we find, when pure, is simply cellulose. But the converse does not hold good; cellulose is not necessarily cotton. Before it can become such it must be made to assume the form of very complex fibres.

Natural products of the second class may therefore be considered for the present, and doubtless for a long time to come, quite safe from the competition of artificial substitutes.

Not so those of the first class. There is at present a rage

for effecting what are called "organic syntheses." This term is somewhat incorrect, since the bodies obtained are for the most part produced not from their elements, but from the residues of organic matter. Be this as it may, it is certain that not a few chemists of consummate ability direct all their attention to the artificial production of organic bodies. It is a somewhat curious coincidence that the chemical laboratory of the University of Munich, which in the days of Liebig was the centre of earnest and successful efforts for the improvement of agriculture, should now, under Prof. Baeyer, have become the focus of a war against agriculture.

The motives for these endeavours are not far to seek. If a chemist can produce any substance artificially, it is no doubt a confirmation of his theoretical views on its constitution. But we must notice that these attempts are made almost exclusively upon substances which possess a considerable commercial value. Hence the inference is suggested that the object in view is not so much the advancement of Science as the acquisition of gain.

Another motive is the economic heresy of protectionism. In almost all civilised countries the opinion seems to be gaining ground that it is better to produce everything which is needed at home, even if at much greater cost, rather than import it from abroad.

Lastly, the endeavour to obtain some given product artificially, or at least from novel sources, may be made with the intention, avowed or tacit, of injuring the country whence the supply was formerly drawn.

I will now give a few instances of the manner in which this movement has been carried on. My first case is one where an article extensively used in human food has been produced not artificially, but from a totally novel source. I refer to sugar, which up to the earlier part of the present century was obtained exclusively from the sugar-cane, and was of course imported into Europe from the Antilles, South America, India, &c. Unfortunately—I use the word advisedly—the observation was made that the beet-root contained a kind of sugar apparently identical in its chemical and physical properties with that of the cane. This observation might have remained dormant, but the first Napoleon, being then engaged in a desperate war with England, and having vainly endeavoured to attack our sugar-growing provinces (or "colonies" as they are still called), took the matter up. To his far-seeing mind it was at once clear that beet-root sugar might be used as a weapon

against this country. No great success was achieved at first, but the idea was not abandoned at the fall of the first French empire. On the contrary, it was taken up in Belgium, Germany, Austria, and Russia; and by dint of great perseverance, a wonderful amount of skill,—both chemical and mechanical,—and lastly, though not least, by duties on the importation of colonial sugar, and by bounties on the exportation of the beet-root product, it has become a formidable rival to the true sugar. What would have been the case in an open market, especially if the same amount of scientific skill were applied to the cane as to the beet-root, may, however, still be doubted.

Beet-root sugar, when refined,—in other words, when freed from extraneous matter,—is, as I have before intimated, generally considered not merely equal to, but identical with, cane-sugar. Latterly, however, doubts are springing up. Some persons, possessing a very delicate organ of taste, profess that they can distinguish the two, and hive-bees are said to refuse beet-sugar if cane-sugar is within reach. One thing is certain: the beet-sugar has done very serious injury to certain important British colonies, to the trade between them and the home kingdoms, and to the sugar-refiners of England and Scotland.

But cane-sugar, whether obtained from the cane or the beet, finds a formidable rival in glucose, a lower kind of sugar produced by the action of sulphuric acid upon starches, and especially upon those of maize and of the potato. Glucose, it must be remarked, is not chemically identical with true sugar; it has a lower sweetening power, and fortunately so far it refuses to crystallise, so that it cannot be introduced into lump sugar, or into the beautiful crystalline product once made by Finzel. But it is largely used in some parts of the world in the adulteration of soft sugars and honey, in the manufacture of jams, of various sweetmeats, and of wines. Now glucose as it occurs in Nature, though less sweet than cane-sugar, is a perfectly wholesome substance. Not so the artificial glucose made from the potato. It contains certain products which on fermentation yield amylic alcohol—the notorious "fusel" oil. Hence wines, spirits, cordials, &c., obtained from the fermentation of such glucose are decidedly unwholesome. Even in the unfermented state it is to be viewed with suspicion, as articles of food sweetened with it are very apt to occasion symptoms of indigestion.

Glucose must, in short, be regarded not as an artificial sugar, but as an adulterant, and it is to be regretted that it

is permitted to be sold under such deceptive names as "new process sugar." There is great reason to fear that the manufacture of glucose will be an injury both to the consumers and the producers of sugar.

There are a series of chemical compounds which, some thirty years ago, were introduced into commerce with great flourish of trumpets, and which are still largely used in flavouring confectionery, beverages, &c. I refer to certain compound ethers which simulate the taste and smell of the pear, the apple, the pine-apple, the raspberry, the melon, the quince, &c. That these ethers are really present in the fruits in question is not proven, and there is reason to suspect that —despite their similarity in flavour and odour to the characteristic principles occurring in these fruits—their physiological action is different, and their use of doubtful safety. However this may be, these essences have not affected the cultivation and sale of fruit. That, thanks to their aid, jams are now concocted in America and elsewhere which contain not a particle of fruit, is an unpleasant fact.

The reader will perhaps be surprised to learn that an attempt has been made to obtain artificially coffee and cocoa, or at least their essential principles, caffeine and theobromine. These bodies have actually been produced, though whether at a remunerative price I am not prepared to say. The raw material is xanthine, one of the ingredients of Peruvian guano,—in other words, of the dung of sea-fowl! Even, however, if caffeine and theobromine can be thus obtained as cheaply as in the natural way, it does not follow that coffee and cocoa can be artificially produced in their entirety from this somewhat repulsive source.

Vanilla ranks among the tropical products endangered. Several processes for its formation have been devised. By one of these it is elaborated from coniferine,—a semi-fluid matter found beneath the bark of pine trees,—whilst in another the essential oil of cloves is the starting-point. The actual production of this aromatic principle, so as to be every way identical with the natural growth, is beyond all dispute. But it may still be questioned whether the project is commercially successful, since the cultivation of the vanilla plant in Trinidad, Mauritius, the Seychelles, &c., is in a very flourishing condition, and the planters are reaping a most satisfactory profit.

Turning from dainties to medicines, we find that most persevering attempts have been made at the artificial production of quinine. It is almost a trite saying that Mr. Perkin was seeking to form this drug when he came upon

the original aniline-violet. Tidings have lately come that Prof. E. Maumené, a very eminent French chemist, has actually succeeded in obtaining quinine artificially, and at a very small outlay in labour, plant, and materials. Danger threatens the cinchona planter from another quarter. Chinoline, a coal-tar product, is said to have the same medicinal properties as quinine, but it is unstable, and must be used within a short time after its preparation. We shall soon learn what amount of reality there is in these rumours.

We pass to dye-wares,—the region where the war against agriculture has been most signally successful. I refer, as will be at once understood, to the introduction of artificial alizarine and anthrapurpurine in place of the madder-root and its various preparations, such as garancine, garanceux, azale, pincoffine, fleur de garance, &c. Here, however, it must be borne in mind that the triumph of the artificial compounds took place under exceptionally favourable circumstances, such as may perhaps never occur in any other case. The proportion of desirable colouring-matter in madder-root is very small (say 1½ per cent), and even of that amount a considerable percentage was left in the root, and often wasted. It was also accompanied by a disagreeable fawn-coloured principle, which attached itself more or less to the dyed or printed goods, and had to be removed—a process requiring much trouble and nicety. The artificial alizarine and purpurine were therefore at once adopted by the trade.

A prolonged and serious attack is being made upon indigo by Prof. Baeyer. There can be no doubt that he has succeeded in forming indigo-blue, the colouring-matter of indigo. But so far at least he has failed to produce it at a price low enough to compete with the natural article.

But indigo has found rivals in certain artificial colouring-matters, which, without claiming to be identical with it, can under many circumstances be used for the same purposes. I may mention especially the indophenols and the indulines. Hence there is good reason to fear that the indigo trade may have seen its best days. There are, however, certain consolatory points; the growth of the indigo-plant and the extraction of the colour are both capable of great improvement. It is not impossible that by care the value of the crops might be raised 25 to 30 per cent above their present average.

As an instance that factitious products do not always succeed in underselling and displacing the natural growth, I may mention the artificial orchil of MM. Vogt and

Henninger. The colour obtained is identical with that extracted from orchella weeds, but the result is more expensive, and the invention consequently remains a dead letter.

I have thus given not a catalogue, but merely a few instances of the attempts made to displace some natural products by artificial compounds. It may afford matter for thought to our statesmen, economists, and men of business, if they note that nearly all these cases are attacks upon British commerce. In face of such a movement it is surely our duty to derive all the practical benefit we can from the teachings of Science, and, by increasing the yield and improving the quality of our colonial productions, render it less easy for them to be superseded.

III. CRUELTY TO ANIMALS.

By W. Mattieu Williams.

THE letter of Mrs. Kingsford, M.D., on the above subject, in the April number of the "Journal of Science," supplies a curious example of the self-stultification of mere sentimentalism. It is evident, by the coupling of her vegetarianism with her total abstinence from "feather and fur wearing," that in her case the abstinence from pork, beef, and mutton is supposed to be an act of benevolence towards pigs, oxen, and sheep.

Suppose we were all to follow the vegetarian example, how would it affect these animals? The answer is evident enough. It would bring about their extermination, unless we preserved a specimen or two in the Zoological Gardens.

As it is, our carnivorous proceedings are most beneficent in reference to animal life. There are no creatures on the face of the earth who, from a merely animal point of view, lead so enviable a life as those which constitute our flocks and herds, and our domestic poultry. They are provided with food and lodging of the very best kind they are capable of enjoying; the best efforts of Science are devoted to the selection of their food, and prizes are given to those who are the most successful in pampering them. They are supplied

with human servants, who tend them with the greatest care, who drive away their natural enemies (flies and maggots included), who watch the state of their health, nurse them when ill, supply them with medicine, attend at their accouchments when necessary, and do everything possible for their general welfare.

In all this world of ours there is no other set of animals enjoying so much animal happiness as these, and yet the sentimental vegetarians cruelly advocate the extinction of all this pastoral bliss that has been a leading theme to poets of all ages.

But Mrs. Kingsford will perhaps reply that we undo and reverse all this by killing them at last. If we are to be denounced for giving life and happiness to each individual for a limited period only, then must these vegetarians similarly denounce the Creator of ourselves and all the rest of the animal world for giving us life, and at the same time making death one of its necessary conditions.

The vegetarian who bases his system of diet on pure and unaffected selfishness, without any goody-goody pretences, may be perfectly consistent in believing that it is better to prepare the organic compounds of vegetables by the aid of scientific cooking than by passing them through the digestive and assimilating organs of animals. He has within reach physiological arguments that are not easily refuted, especially in a warm climate, and he may fairly add to these the natural instinct or sentiment that regards the carcase of a red-blooded animal as a very repulsive object; but from the humanitarian point of view he is far more cruel than the flesh-eater, not only for the reasons above stated, but on account of the number of individual animals he slaughters, if such killing is to be regarded as cruelty; for the boiling of a cabbage involves the immolation of innocent slugs and caterpillars, and tens or hundreds of thousands of Aphides are sacrificed in topping a row of broad beans, to say nothing of the millions of Colorado beetles that have been mercilessly murdered in order that ruthless selfish man may satisfy his greed for potatoes.

If the scheme of Creation were based on the principle of sacrificing the higher animals for the benefit of the lower, and the race for the individual, the anti-vivisection sentimental and vegetarian sisterhood would be in harmony with Nature; but as it is, they should open their meetings not with prayer and praises, but with denunciations of the Omnipotent who has constructed this world and all its inhabitants on a principle diametrically opposed to their

superior ideal. They should revert to the ancient idolatries which worshipped bulls and snakes and beetles, in temples erected to their honour.

IV. ON THE APPLICATION OF SOLAR PHYSICS.

By A. H. Swinton.

BARON VON HUMBOLDT complained of Sir John Herschel that, as usual, that distinguished astronomer had pursued his investigations independently of others; and the retort of the British press has been—What a pity it was that the distinguished Baron should have spent so many years in the prime of life working up his travels and researches. We may draw, I think, from this the conclusion that the happy mean, as regards philosophical research will be found to lie between the two aphorisms—original investigation means progress, but original investigation is enhanced in its value when it is referred to its place in the archives of the past. I propose at the present time, then, to take a somewhat wider glance over the domain of Solar Physics, and at the same time to discuss a much-vexed topic that lies at the root of the inquiry. With the assistance of a ready reference to be found in a pamphlet entitled "Ueber die Beziehungen der Sonnenflecken-periode zu Meteorologischen Erscheinungen," von D. F. G. Hahn, and an article on Sun-Spots and Famines, by Messrs. Norman Lockyer and J. Hunter, contained in the "Nineteenth Century" for 1877, I was lately enabled to systematically turn over a very considerable portion of the recent sun-spot literature that has taken shape of late years in the "Philosophical Transactions," "Nature," the "Memoirs of the Royal Astronomical Society," and some few of the meteorological journals. I likewise found that more papers were to be had in "Silliman's Journal," and other American publications. As regards Germany, I was referred to the "Berichte der Königlich Sächsischen Gesellschaft, der Wissenschaft"; and as regards Switzerland, to the "Astronomische Mittheilungen," and

other publications emanating from Zurich. Then as regards Austria, there was the "Zeitschrift der österreichischen Gesellschaft für Meteorologie," the "Denkschrift der Wiener Academie," and other works; as regards France, the "Comptes Rendus"; and as regards Belgium, the "Mémoires de l'Académie Royale de Bruxelles."

It however requires, I think, but a cursory glance over these endless papers, to show that the tabulation of sun-spot phenomena has at length taken a certain definite shape, and that the chief results are already known. But what is not a little curious, it will at the same time be discovered that certain outstanding questions have arisen out of the enquiry where a difference of opinion is expressed. Take, for example, the question—Is the sun hottest when it has fewest or most spots on its face? This looks simple, and yet some argue one way and some the other. Are the spots a defect in the photosphere, or are they the indications of a period of solar energy? Experiments with the black bulb thermometer, between the years 1837 and 1869, brought Prof. Piazzi Smyth to the conclusion that at Edinburgh a great heat-wave occurs every eleven years and a fraction, its maximum slightly lagging behind the minimum of the sun-spot cycle. Mr. E. J. Stone, at the Cape of Good Hope, from the temperature observations recorded during thirty years, came to a similar conclusion; and Dr. W. Köppen, in his elaborate paper, finds that in the tropics the maximum of warmth occurs a full year before the year of minimum sun-spots, while in zones beyond the tropics it falls two years after the minimum. This would incline us to the opinion that the period of fewest sun-spots is the warmer of the two, which is certainly the impression on the writer's mind; but let us look to the physical side of the question.

The heading of the physical enquiries from which opinions on the subject may be drawn are, of course, the winds and rains, the seasons and agriculture, and the magnetic and seismic phenomena. First, the winds and rains: these, as is generally admitted, come on at the period of most sun-spots; 1879 is an example of a disastrous and wet season occurring at such a period. Some say wind and rain mean that the sun has then greater energy; but it must be added that this does not so clearly make out a case of greater heat, since cold is likewise an essential to locally condense the atmosphere, and so to raise the wind and saturate the air. We may illustrate this point by remarking that wind and rain are characteristic of the colder, and not the warmer, portion of the year. Then magnetic disturbances likewise

occur at the period of most sun-spots; but here, again, I am not aware that there is any proof to show that these disturbances are the result of a thermal storage of electricity at this time. From Dr. R. Capron's work on the "Auroræ and their Spectra" we learn that these disturbances, which are of the same nature as thunderstorms, occur mostly in March and October; that their curves of greater frequency tend towards the region of atmospheric pressure, and that they bear the same relation to the limit of perpetual ice. This, as I take it, refers their causation, like the wind and rain, to a differentiation in the temperature. As regards the seismic disturbances, earthquakes quiver and volcanoes are active at two points in the sun cycles. They break out when the sun-star has fewest, and again when it has most, spots on its photosphere. This remarkable truth, as far as I can learn, was first enunciated in its entirety by Dr. Fuchs, in his pamphlet "Die Vulkanischen Erscheinungen der Erde," published in 1865; but some thirteen years earlier we find it related, in the publication of the "Naturforscher Gesellschaft" of Bern, that a discussion had arisen between Prof. Wolf and M. E. Kluge as to whether it was a fact that the Auroræ Boreales and earth tremors accumulated during the years when the sun-spots were most prevalent and the magnetic variations were most remarkable. Still if anyone will take the trouble to tabulate the eruptions of Etna and Vesuvius,—say between 1755 and the present time,—I think the only wonderment that will arise in his mind will be, How is it that this matter was not found out long before? It is ages since old mother Etna was discovered to be the poor man's weather-glass. Sir John Maunderville, that most susceptible and credulous historian of the East, relates—"Also in that isle, Sicily, is Mount Etna, which men call Mount Gybell, and volcanoes that are ever burning. And there are seven places which burn and cast out flames of diverse colours; and by the changing of those flames, men of that country know when it will be dearth or good time, or cold or hot, or moist or dry, or in all other manners how the time will vary." But do the earthquakes and eruptions inform us whether the sun is colder or warmer when it is most spotted? Allowing these may be due to the thermal expansion and contraction of the earth's crust producing lateral thrust, it would not appear that any positive data are possible, unless it can be certainly stated when the earth's surface is most expanded and when it is most contracted. The eruption of volcanoes and the earthquakes might result from excessive expansion or extreme contraction,

since the lowering or raising of the soil would alike open a vertical orifice.*

Then as regards the seasons and their passing features, Dr. Hahn has constructed a table of mean temperature, from which it would appear that the cold summers and winters follow the maximum of sun-spots, and the warm summers and winters the minimum; and, according to his view, it is the warmth and dryness of the interval between the minimum and maximum period that accounts for the appearance at this conjuncture of locusts in Europe. As to this last assertion, however, I think some latitude must be allowed, as at times stray locusts arrive at the shores of the United Kingdom a few years previous to the minimum epoch; nor is it very evident, from Dr. Hahn's temperature table, that the warm years that arrive at the epoch of fewest sun-spots last until the succeeding maximum. So then, as before, the temperature observations associate the warm summers with the minimum of sun-spots, and it is an old adage that it is the warm years which bring the locusts. It is, however, somewhat satisfactory to learn that the periods of multiplication of certain insects more disastrous to our home-produce than locusts do not coincide here in point of time. By referring the species to the orders to which they belong, I think we may gain from tabulation that crane-flies (Tipulidæ) have multiplied in this country at the maximum epochs, destructive moths (Noctuidæ at the same period; and that, on the other hand, corn weevils (Rhynchophora), and perchance certain saw-flies (Tenthredinidæ), have multiplied at the minimum epochs.

* When writing my last paper on Solar Physics ("Journal of Science" for March, 1882) it had escaped me that Prof. Wolf had already given an approximation of the sun-spot cycles carried back to 1610, from certain records extant: they differ but in few instances from those I have calculated. I also should have said (page 158) that the cycles lengthen in all appearance at the end of the sixteenth and eighteenth centuries, and are short about 1640: there are certain long periods associated.

V. DEATH NOT UNIVERSAL.

IT may seem at first glance remarkable that a phenomenon so superabundantly dealt with as Death has been, by orators, novelists, poets, and divines, should yet be so much misunderstood. A friend of ours, indeed, suggests that this misunderstanding is the natural consequence of the treatment the subject has received from the classes above mentioned. If the British public would condescend to take its notions of death from the sober teachings of physicians and naturalists it would both learn and unlearn no little.

The first error which we must point out is the popular antithesis between death and life. Such antitheses, as it has been from time to time shown in the "Journal of Science," are at best of doubtful value, being as a rule founded in men's conceptions or misconceptions, rather than in the nature of the things compared. Life may, indeed, be logically contrasted with a state prior to its own commencement or—on the monistic hypothesis—subsequent to its conclusion. But how it can be profitably and logically compared with its own termination is not easily seen. Draw a finite straight line: what contrast exists between such line and the point where it ends? No; if we want something fairly antithetical to death—*i.e.*, to the conclusion of life—we must find it in the beginning of life, that is in birth. Where there is no birth there can be no death. This consideration we shall presently find is not unimportant.

Another notion deeply rooted in the popular mind, and in ordinary literature, is that death is common and necessary to all organic beings. Whatever lives, we hear it said, whether plant or animal, must sooner or later die. It will therefore greatly shock many persons to learn that this is not strictly the case. We wish here to give room for no misunderstanding, and, if possible, for no intentional misinterpretation. All animals *may* die, but death is not in all departments of the animal kingdom an inherent absolute necessity. On the contrary, in one of the two primary divisons of the animal world, the Protozoa, it is, though common enough, merely casual, the result of some accident. A Protozoon may be swallowed up by some larger animal; it may be crushed out of existence, burnt, or poisoned by "disinfectants" introduced into the water or other fluid which it inhabits. But it has no natural term of life, and, as we shall presently see, cannot be spoken of as young or old.

That this may be understood we must briefly compare the life-history, and especially the reproduction, of the *Metazoa* and the *Protozoa*. In the former group—which includes all the back-boned animals from man down to the humblest fish, all the insects, mollusks, as well as lower forms of life which scarcely attract popular notice—there is always a distinct difference between parent and offspring. The latter is certainly a portion separated from the body of the parent, —from the female in all those forms in which there exist two sexes,—but it is as compared with the parent minute in size, rudimentary in structure, and it has to increase in bulk, and still more to undergo a process of development, a series of transformations, before it reaches the normal stature and make of its species. When this point has been attained it enters upon the task of reproduction, and gives birth to one brood of young ones, or in the higher forms to several. With these it co-exists for a longer or shorter time, and then dies, the matter which constituted its body passing into decomposition. If we look at these very familiar facts in the life of a Metazoon, be it a man or an oyster, we find that the ideas of birth, of growth, of maturity, of parenthood, of a natural term of life ending in death, at once suggest themselves. If we examine such a Metazoon we can, in most cases, at once decide whether it is in the immature or the adult phase of its being.

But in the *Protozoa*—as Herr Bütschli has not long ago pointed out in the "Zoologischer Anzeiger"—this is distinctly different.

Let us suppose we are watching through a microscope one of these minute single-cell creatures. We see it expanding into an ellipsoidal figure, which becomes for a time longer and longer. It then begins to contract about what we may, for the sake of popular intelligibility, call its equator. It assumes the form of two nearly globular bodies, connected, dumb-bell like, by a narrow neck. This neck becomes narrower and narrower, and at last the two globes are set free, and appear as two individuals in place of one! What are the relations of these two new beings to the antecedent form and to each other? We examine them with care; they are equal in size, alike in complexity, or rather simplicity, of structure. We cannot say that either of them is more mature or more rudimentary than the other. We can find in their separation from each other no analogy to the separation of the young animal or the egg from its mother, or to the liberation of a seed from a plant. Neither of them is parent, and neither offspring. Neither of them is older or younger than the other.

Or shall we try to regard them as brothers, sprung from the same parent? If so, where is that parent? If living, let it be shown; if dead, where are its remains? No organic —or indeed any other—matter was separated out when the two new beings took their rise. All the substance of the body of the original Protozoon is included, and equally included, in the bodies of the two individuals before us. Thus we see that the essential ideas of the life of the higher animals—birth, growth, maturity, parentage, brotherhood, term of life, and successive generations—have, if applied to these humble and minute beings, simply no meaning.

The process of reproduction, or rather of multiplication, must, as far as we can see, be repeated in the same manner for ever. Accidents excepted, they are immortal; and frequent as such accidents must be, the individuals whom they strike might, or rather would, like the rest of their community, have gone on living and splitting themselves up for ever. It is strange, when examining certain Infusoria under the microscope, to consider that these frail and tiny beings were living, not potentially in their ancestors, but really in their own persons, perhaps in the Laurentian epoch!

This consideration opens up another question. These beings are not wholly unconscious. They experience and retain impressions, however dimly and in however limited a sphere. But when the splitting up one individual into two distinct personalities takes place as we have described above, we have then the curious phenomenon of two distinct and equal beings whose past life is one, who will remember the same incidents and the same reactions to which such incidents have given rise. Here again is a phenomenon which we cannot realise,—two contemporary and coequal beings possessing, up to a certain point at least, a common psychic life. Let us for a moment suppose that the propagation of the higher animals took place in a similar manner. We should see, *e.g.*, the mature man split up into two equal and similar men, each remembering, knowing, believing, and feeling, up to the day of fission, all that the other remembered, knew, believed, or felt; each, too, it might be contended by moralists, equally sharing the merits or demerits of the antecedent form, and each at a loss to say when his own personality took its rise.

VI. OCCULTISM RECONSIDERED.*

WHEN, about a year ago, it became our duty to examine the first edition of Mr. Sinnett's extraordinary work, we did not feel free, like some of our contemporaries, to dismiss the author and his subject with a contempt scarcely kept within the bounds of ordinary courtesy. On the contrary, we should have been glad—too glad—if we could have laid our finger upon some proposition and proclaimed it demonstrable truth, how fully soever it might clash with the orthodoxies of Science. Our search was unrewarded, and we closed the book with a deep feeling of disappointment. We were not sorry, however, on the appearance of this second edition, to re-open the question, and, as far as possible, to attempt to present the views of the Occultists in a systematised form, and exhibit their apparent relation to the Philosophy and the Science of the modern world. That our success in this attempt will be but very imperfect we foresee. We never met with a book in which definite, tangible, verifiable statements were so purposely and skilfully avoided.

Like the author, we will begin with noting the relations of Occultism to Spiritualism. The two are not, as is commonly supposed, identical.

Mr. Sinnett makes, indeed, the significant remark that it is not his "present task to make war on Spiritualism." He remarks that the announcements he has to make "will be probably received more readily among Spiritualists than in the outer circles of the ordinary world." He admits the facts of Spiritualism, but he contends that its phenomena are manifestations which mediums can neither control nor understand, whilst occult phenomena are achievements of a conscious living operator comprehending the laws with which he works. If such achievements appear miraculous, that is the fault of the observer's ignorance. The Spiritualist, it is asserted, is very reluctant to tolerate the production of a new hypothesis which will compel him to reconstruct his views almost from the beginning.

We turn to the relations of Occultism to Modern Science,

* The Occult World. By A. P. SINNETT. Second Edition. London: Trübner and Co.
Zanoni. By Lord E. BULWER LYTTON.
A Strange Story. By Lord E. BULWER LYTTON.

or, as we prefer to call it, Open Science. These relations are not too clearly expressed, and apparently not too amicable. We read (p. 1) that "modern metaphysics, and to a large extent modern physical science, have been groping for centuries blindly after knowledge which occult philosophy has enjoyed in full measure all the while." The author tells us that he has come in contact with persons who are heirs of a greater knowledge concerning the mysteries of Nature and humanity than modern culture has yet evolved." He admits, indeed, that "modern science has accomplished grand results by the open method of investigation. Yet he tells us that secluded Orientals may understand more about electricity than Faraday, more about physics than Tyndall," and that "adepts of occultism are capable of exhibiting results that prove them immeasurably further advanced than ordinary modern science in a comprehension of the forces of Nature," though all the time "physical science has merely been an object for occultism of secondary importance." These assertions of the superiority of Oriental Science may be in accordance with facts or they may not, the data for a decision being wanting. But in order to show the manner in which our ordinary open science is judged in the work before us, the reader must be introduced to an adept of high rank in the Occult Brotherhood—Koot Hoomi Lal Singh. This gentleman is apparently a Sikh by birth. In his youth he was sent to Europe "to be educated in Western knowledge, and since then has been fully initiated in the greater knowledge of the East." Several of his letters are given in full, and their contents seem to be endorsed by Mr. Sinnett as the authoritative teachings of Occultism. Among the first points which strike us are certain plain misconceptions as regards the history and the teachings of open science, which come with scant grace in a treatise where such science is spoken of with undisguised contempt. Thus we read (p. 96),—"Experimental knowledge does not quite date from 1662, when Bacon, Robert Boyle, and the Bishop of Chester transformed, under the royal charter, their 'invisible college' into a society for the promotion of experimental science." Surely it is well known that Bacon was dead prior not only to the incorporation of the Royal Society in 1663, but even to its private formation in 1645. What is of much more importance, no one in Europe supposes that experimental open science took its rise at so recent a date. Without referring to the comparatively modern researches of Torricelli, Gilbert, and others, we may point to the Book of the Balance of Wisdom, which shows that in the twelfth century

the Arabian philosophers investigated Nature just as we do, by experiment and observation, and published their discoveries in plain language. The same may be said of the true Greek philosophers, such as Thales, Empedocles, Democritus. Going still farther back, we find an Egyptian medical treatise, the "Papyrus Ebers" (of the date 1552 B.C.), clear and open in its teachings, and written in a manner which shows that the observation of natural phenomena and committal of experience to writing—as we should now say, publication—were not things of yesterday. Hence we have proof that, contrary to the dictum of Mr. Sinnett (p. 3), for some 4000 years men of Science did not exclusively work in secret, or teach their discoveries merely "in secret to carefully selected pupils." In fact the burden of proof lies, we should say, with those who maintain that Occult Science is the elder. The culture of Europe has "*not* been developed by Europeans for themselves within the last few hundred years."

But not merely is the history of open science apparently misunderstood, its present views and its future aims are not fairly set forth. Thus in a letter of Koot Hoomi Lal Singh's (p. 97) he is made to say—"The very existence of those gigantic ancestors of ours is now questioned,—though in the Himavats, on the very territory belonging to you, we have a cave full of the skeletons of these giants, and their huge frames, *when found*, are invariably regarded as isolated freaks of Nature." Now if there is one error of the past more completely and unanimously rejected by Modern Science than another, it is that of regarding fossils as *lusus Naturæ*. We call attention to the words we have italicised, which seem to imply that such skeletons have been found. By whom? Had they fallen into the hands of the Geological Survey of India the whole world would have been aware of every particular.

Again, we are told on p. 132—also by Koot Hoomi Lal Singh—that "the philosophical and transcendental notion of the mediæval Theosophists, that the final progress of human labour, aided by the incessant discoveries of man, must one day culminate in a process which shall result in the evolution of nutritious food out of inorganic matter, is unthinkable for men of Science." A more mistaken accusation was never brought forward. The great object of modern chemists is the evolution of organic compounds—commonly so-called—out of inorganic matter, and the many striking successes which they have achieved in the last few years merely urge them on to further attempts. The synthesis of

human food may not be effected this century or the next, but it is kept fully and clearly in view as the great goal of applied science.

Hence we submit we have shown that the history, the teachings, and the aims of open science do not receive full justice at the hands of Mr. Sinnett.

We may now cast a glance at certain important and fundamental distinctions between Occultism and Open Science. Koot Hoomi Lal Singh is quoted as saying—"You do not seem to realise the tremendous difficulties in the way of imparting even the rudiments of our science to those who have been trained in the familiar methods of yours. The more you have of the one the less capable you are of instinctively comprehending the other." Open Science, as we know, is purely intellectual. It is attained by intellectual training only, other pursuits—whether in themselves morally good or evil—being discarded as distractions. In the book before us Koot Hoomi complains of modern civilisation as resting so exclusively upon intellect. He complains, even, that "exact experimental science has nothing to do with morality, virtue, philanthropy." He asks, censuring, "What have the laws of Faraday, Tyndall, or others to do with philanthropy?" The training of the adept is not purely intellectual, but seems to involve a certain amount of asceticism. There is required amongst other things "a life of absolute physical purity"—whatever these words and their subsequent explanation may mean. The type of the adept here given is thus widely different from Lord Lytton's Mejnour. He, if an ascetic, was so like not a few of our modern men of Science, simply from complete absorption in his studies. He is described not as a philanthropist, but as purely intellectual in his pursuits. With him life "is but a power to examine."

Passing to the tenets of Occultism as compared with those of Open Science, we find, in the former as in the latter, the recognition of the immutability of law, and of the principle of continuity. Evolution seems to be admitted, and perhaps even abiogenesis, since the object of Nature is proclaimed to be (p. 129) "the evolution of conscious life out of inert material." The age of miracles is declared not to be past, but never to have existed. Concerning energy a remarkable difference of views must be noted. Says Koot Hoomi:—"You see no difference between the energy expended by the traveller who pushes aside the bush that obstructs his path and the scientific experimenter who expends an equal amount of energy in setting a pendulum in motion. We do; for we

know there is a world of difference between the two. The one uselessly dissipates and scatters force; the other concentrates and stores it. And here please understand that I do not refer to the relative utility of the two, as one might imagine, but only to the fact that in the one case there is but brute force, flung out without any transmutation of that brute energy into the higher potential form of spiritual dynamics, and in the other there is just that." We must frankly own our entire inability to attach any meaning to these words, or to conceive the possibility of the motives of an action having any influence upon its physical conditions. In a similar strain Koot Hoomi continues:—"Still less does exact Science perceive that while the building ant, the busy bee, the nidifacient bird, accumulates each in its own humble way as much cosmic energy as a Haydn, a Plato (!), or a ploughman turning his furrow in theirs; the hunter who kills game for his pleasure or profit, or the positivist who applies his intellect to proving that $+ \times + = -$, are wasting and scattering energy no less than the tiger which springs upon its prey. They all rob Nature instead of enriching her, and will all in the degree of their intelligence find themselves accountable." Perhaps Koot Hoomi here forgets two things—that the "positivist" has small respect for a life of scientific research, and places the solving of equations upon a par with the pointing of pins; and secondly, that the "building ant" is size for size a greater destroyer than the tiger.

Again:—"Heat is but a mode of motion to her (*i.e.*, to Science), and motion develops heat, but why the mechanical motion of the revolving wheel should be metaphysically of a higher value than the heat into which it is gradually transformed she has yet to learn."

A prominent part is played in Occult lore by a mode of energy, if we may so call it, named *akas*. This, the author says, "is a force for which we have no name, and in reference to which we have no experience to guide us to a conception of its nature. One can only grasp at the idea required by conceiving that it is as much more potent, subtle, and extraordinary an agent than electricity, as electricity is superior in subtlety and variegated efficiency to steam,"—a description which, we submit, throws not a ray of light upon its nature and properties. There is not even a reference to any natural phenomenon in which this unknown form of energy plays a part. We are merely told that by its means the adept can transport material objects to any distance, disintegrating them, conveying the particles through the air

or through solid bodies, and again re-uniting them into their original form! Certain phenomena brought forward in this book as evidence of the reality of Occultism, and of the powers of its votaries, appear to turn upon a display of this force.

Passing from Physics to Psychology, we find the so-called Materialist view rejected with some emphasis. Man is regarded as a threefold being, composed of body, soul, and spirit. We may here remark that on this subject some variety of opinion prevails. The ordinary hypothesis—as held by all the orthodox religious bodies and by many metaphysicians—views him as consisting of two principles only, body and soul or spirit, the two latter being regarded as synonyms for an immaterial entity. On the other hand, certain mystics and mænads seem to regard man as a fourfold being. The soul, according to Mr. Sinnett and his guides, is, however, not spiritual, but material.

(To be continued.)

VII. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

(Continued from page 290.)

ENGLAND, it has been stated, with a great deal of truth, is the country of "*Cries and Catchwords.*" This national peculiarity is owing no doubt in a great measure to the public life of the country being carried on by means of parties. "A liberal education" is a very favourite catchword at the present time, but for one person who uses the phrase intelligently a thousand at least, it is to be feared, use it unintelligently. "Technical education" and "Payment by results" are also popular cries; yet of the number who are admirers of the system of payment by results for teachers, how many out of the number have ever seriously tried to ascertain whether the system has proved a success? It is to be feared that in this case also the majority make use of the phrase simply as a cry, never investigating, or

attempting to investigate, whether the system has worked well for the advancement of scientific and technical education in the kingdom.

One great obstruction to the establishment of schools suitable for the middle class—and without such schools our technical colleges will avail us little in improving and extending our manufacturing industries—is owing to the English people confining the meaning of the term "a liberal education" solely to a classical education. A classical education was no doubt the best that could be framed in earlier times, and it is probably the one most "suitable for the higher classes in the present day," but boys who are intended for a manufacturing or a commercial life require to be taught subjects that will train their mental powers as—if not more—perfectly, and will enable them to discharge their duties in after life more efficiently.

English people have not realised, like other peoples have done, that a different education is required by the different classes,—that the system of school education to be adopted ought to be determined by the wants of the particular class to be educated; hence England lags behind other civilised countries in educational progress. *We continue* to dress our children's minds as we do their bodies, in the prevailing fashion; and a classical education is the fashionable education, because it is the education the higher classes receive. "If we inquire," Mr. Herbert Spencer states, "what is the real motive for giving boys a classical education, we find it to be simply conformity to public opinion. We are guilty," he states, "of something like a platitude when we say that, throughout his after career, a boy, in nine cases out of ten, applies his Latin and Greek to no practical purposes. The remark is trite that in his shop or his office, in managing his estate or his family, in playing his part as director of a bank or a railway, he is very little aided by this knowledge he took so many years to acquire—so little that generally the greater part of it drops out of his memory; and if he occasionally vents a Latin quotation, or alludes to some Greek myth, it is less to throw light on the topic in hand than for the sake of effect."

The merchant, the trader, the producer, the constructor, and the inventor, have always in the past found knowledge to be power; and in the present day it is a still more important factor for success in buying and selling, in manufacturing and constructing, and in inventing, in consequence of competition being so much keener, not only between individuals belonging to the same nation, but between competitors

of different nations, the markets also being more numerous and larger, and present improvements in manufacturing industries being the outcome of higher scientific knowledge than those in the past required for their successful carrying out far more scientific skill than the older and cruder ones did; and the requirements and tastes of the people of all countries are ever increasing and ever changing, and therefore the manufacturer who would be successful in the present day must be constantly anticipating the wants of the public by new inventions.

Although England has contributed a goodly number of those educational reformers who have from time to time appeared with new and improved methods for teaching the very young, no one has yet come forward in this country with a good system of school education suitable for boys intended for commercial and manufacturing pursuits. The reason no doubt is due, in a great measure, to the fact that all the chief appointments in our grammar and other public schools have been occupied exclusively by clergymen whose education, both at school and the university, has been that based on the requirements of the Middle Ages. It could not be expected that there would arise from this class of teachers a reformer who would strike out a course of study for youths that would fit them best for their future employments in commerce or manufactures; and as they exclusively occupied the chief scholastic situations, and imposed on the country the system of school education adopted, they prevented laymen from taking part in educational reforms. It is true that many of our scientific men have given evidence before Commissions, and addressed the public—either on the platform or through the press—on the necessity of introducing one or more of the Inductive Sciences into the course of school studies, but I am not aware that any of them has yet propounded a complete course of studies for boys of the middle class. Nay, they have not even discussed the best methods of teaching the induction sciences in schools, but have been contented to continue antiquated methods or accept newer ones at second-hand. Although boys intended for manufacturing pursuits ought to lay the foundation-stone of knowledge of one or more of the inductive sciences at school, there are other subjects more important than the inductive sciences which boys intended for trade and commerce ought to be taught.

Instead of establishing, as other countries have done, schools in which the course of instruction given is suitable for the wants of the middle class, we are trying to combine

both systems of education—the old and the new—in the same institution : this will at least prove less successful than the one other countries have adopted. Mr. Matthew Arnold observes, in reference to this subject, in his French Eton,—"On the Continent of Europe a clean sweep has in general been made to the old form of scholastic establishment, and new institutions have arisen upon its ruins. In England we have kept our great school and college foundations, introducing into their system what correctives and palliatives were absolutely necessary. Long may we keep them ! but no such palliatives or correctives will ever make the public establishment of education which sufficed for earlier ages suffice for this. . . . That is where England is weak, and France, Holland, and Germany are strong."

I have dwelt at some length on the necessity of having suitable schools for the middle class, for this is the first educational requirement for those intended for commerce and manufactures. Without such schools all other plans for promoting and improving technical education in this country will prove inefficient. I know from personal knowledge that many young men are going to our technical colleges who are utterly unprepared to benefit by the instruction given. I met one not long ago, in London, who was attending lectures and a laboratory devoted to brewing. He knew nothing whatever of the language of the science ; and, as language is the nutriment of thought, from not knowing it the atmosphere in which chemical thought lives was wanting. I do not mean to imply that he would not be able to remember isolated facts, but what I assert is that he was not able to reason about them ; he was not able to judge what they proved, and how, through the facts he knew, to get at others which it might be desirable for him to know.

ANALYSES OF BOOKS.

The Scientific Basis of National Progress, including that of Morality. By G. Gore, LL.D., F.R.S. London: Williams and Norgate.

We have here an able and earnest plea for the furtherance of scientific research considered as the essential condition of national progress. The author's leading idea is that present knowledge can merely enable us to maintain our present state, whilst any advance must be derived from new knowledge. Unless new discoveries are made, inventions and improvements must sooner or later cease. This idea, we think, must be in the main accepted. It may indeed be contended that a portion of the knowledge we at present possess is not utilised, and that, even when it has been brought into the tangible form of an improvement or invention, it may still remain for years a dead letter. With us, indeed, the inventor is in a painful dilemma. Let his device be never so clearly demonstrated, the mob of so-called practical men still hold back. If business is brisk—perhaps some of our readers may be able to carry their memories back to such a time—the average John Bull is apt to say that that there is no need of improvement, and that an economy of a few hundreds of pounds or a slight improvement in quality is not worth "bothering" about. On the other hand, when trade is slack no one has the courage to attempt any departure from established routine. Thus it often happens that the greater the essential value of any invention the greater is the difficulty of getting it taken up. We suspect that the nations who are our chief industrial rivals do not take exactly the same view of novelties.

Dr. Gore works out his fundamental idea in four chapters, treating respectively of the scientific basis of material progress; the scientific basis of mental and moral progress; new truth, and its relation to human progress; and, lastly, the promotion of original scientific research. "The chief object of this book," it is stated, "is to disseminate more correct ideas respecting the importance of *new* positive knowledge, and the duties of society in relation to it; and a further object is to assist in maintaining Birmingham in the front rank of intellectual, social, and moral advance!" We cannot read these lines without putting on record our sorrow that, at least as far as one science is concerned, Birmingham should have taken up a retrograde position, and that the trustees of Mason College should already, at the bidding of organised ignorance, have placed fetters upon an Institution opened with such high hopes and promises. We make these

remarks the rather because the author estimates the Anti-Vivisection "movement" at its just value, as one of the manifestations of the retarding spirit in our midst.

The following passage should give ample scope for serious reflection:—"When famines result from insufficiency of solar heat, instead of investigating the conditions of the sun's surface, to enable us to predict their occurrence and provide accordingly, we allow them to come upon us in our unprepared state, and produce their fearful effects. When contagious disease overtakes us, what do we do? Instead of previously employing and paying scientific investigators to make experiments in physiological and chemical science, to enable us to combat it successfully, we vainly attempt to apply our present stock of chemical and physiological knowledge to ward off the difficulty. When high price of fuel intervenes, instead of previously giving discoverers the means of finding new principles relating to heat and to chemical and electrical action, we ineffectually endeavour by means of invention to economise fuel. These are the pottering, short-sighted, and ignorant ways in which 'the great English nation' temporises with great evils, and permits national welfare to be sacrificed to private gain." This is an unpleasant, a humiliating picture, but is it not too true?

In one part of his work Dr. Gore gives an interesting specimen list of inventions wanted. To one of these we must take emphatic exception. The author thinks it desirable "to find larger uses for phosphorus." We hold, on the contrary, that the only legitimate use for phosphorus is as plant-food in the state of phosphoric acid, and that its appropriation to other purposes, limited as the supply is, should be checked by heavy penalties.

Dr. Gore contrasts the enormous sums of money expended in this country upon *quasi*-philanthropic movements with the tiny driblets which are forthcoming for scientific research. What are the sums thus disbursed by the Royal Society, the British Association, &c., in comparison with the incomes of the Anti-Vivisection, Anti-Vaccination, and other "anti" organisations? This neglect, our author thinks, is due to the ignorance of the wealthy classes. The following passage from a letter from the Duke of Somerset throws some light upon this widespread ignorance:—

"The hindrances to scientific studies in this country are very many. The gentry are almost invariably educated by the clergy, and the clergy have seldom had time or opportunities for any scientific study. They usually take pupils or become tutors as soon as they have taken their degrees, and can only teach the Latin and Greek which they have themselves learned. The commercial classes value what they call practical science: this means some application of science for the purpose of making money. Competitive examinations may promote a superficial acquaintance with the elements of science, but are unfavourable

to the development of scientific culture. The scientific associations tend to degrade science, by exhibiting scientific men as candidates for applause from assemblies which seek amusement and startling results from lectures and experiments. The advancement of science is therefore left to comparatively few men, who are unregarded and unrewarded."

It must be noted that neither the writer himself nor the authorities whom he cites speak of the discouragement to research in England as a feature merely of the past. He and they alike speak of the present, and detect few, very few, signs of any change for the better, South Kensington notwithstanding.

Among the plans suggested for placing research in this country upon a footing as advantageous as it occupies in Germany, the author enumerates—"1st. By founding State laboratories, in which discoverers of established repute, supplied with every aid and appliance, should be wholly engaged in research in their respective subjects, and be paid by the State. 2nd. By founding colleges or Professorships of original research in each of the Universities, and appointing Professors similarly. 3rd. By founding provincial colleges or Professorships of research, the funds being raised locally by means of subscriptions, donations, and endowments, with or without State assistance. 4th. By State or Local aid in the form of additional salary to Professors in colleges, to enable them to pursue research. 5th. By an extension of the present Government grants distributed by the Royal Society. 6th. By making it a condition at each of our Universities that every student entering for a degree in Science should previously make an original research. 7th. By the formation by learned societies of Endowment of Research Funds, and making grants of money therefrom to recognised investigators. 8th. By aid to local investigators by Municipal bodies out of the rates. 9th. The support of Institutes of Research by private munificence." The author remarks, justly enough, that the chief difficulty to be surmounted in carrying out any of these schemes is the very general ignorance in this country of the value and necessity of research.

We can carry our examination of this important work no further. It merits the careful consideration of thoughtful men, as showing that no amount of elementary education—not even the increase in quantity and the improvement in quality of secondary technological training—will suffice. All this is well, but if we wish to lead the world industrially we must keep in advance in original discovery. This object the Germans have pursued now for the last half century, "unhasting, unresting," and the results are making themselves felt. It is still not too late if we will really arouse ourselves, but how long an opportunity will be given us is very doubtful.

Remarks on Certain Medical Principles and Publications. By Dr. JOSEPH HAMERNIK, of Prague. Translated from the German by F. MARKS. London: F. Marks.

THE author of this pamphlet is apparently given to "views." He is an anti-vaccinationist and vegetarian, probably a teetotaller, an opponent of modern sanitary reform—in so far at least as it seeks the cause of epidemics in polluted waters. He is also opposed to blood-letting, to purgatives, to mineral waters, to the parasitic theory of disease, to disinfection, and to the antiseptic method in surgery. Personally he appears to have a strong objection to Prof. Virchow, to Klebs, to Henle, Semmelweiss, and the "medical bureaucracy" in general. In his objections to vaccination—which are possibly the cause why the pamphlet has been translated into English—we find little that can be novel to our readers. He maintains that various diseases, and notably tuberculosis and syphilis, are propagated by means of vaccination; that it affords no protection from smallpox; that during an epidemic vaccinated and unvaccinated are alike attacked, recover, or die, the appearance and conditions of the disease presenting no diversity whatever. He denounces medical statistics and medical logic *in toto*. He writes that "when a few years later [we presume after the introduction of vaccination] smallpox happened to occur less frequently, and in a milder form, the alchemical artists [*sic!*] thought it quite natural that, though only from 5 to 6 per cent of the population was vaccinated, the diminution of smallpox was due to vaccination. Before the great epidemic of 1870-72 the population was vaccinated within about 5 or 6 per cent, large numbers having likewise been vaccinated more than once; and the vaccinators and their adherents were short-sighted or barefaced enough to pretend that the 5 or 6 per cent of the unvaccinated were to blame for the epidemic, and even for the appearance of smallpox at all."

The following *à priori* argument against the possibility of a preventive against smallpox does not throw a very favourable light upon Dr. Hamernik as a reasoner:—"What kind of world-order would that be into which each speculator or impostor could introduce changes in which, for instance, smallpox and anti-smallpox both had place? Would it not be simpler and more natural to omit both?" If the author would look around him he might see the whole world full of conflicting agencies, devised, say the teleologists, to keep each other within bounds, which might have been omitted.

On the liability to take cold Dr. Hamernik writes—"This effeminacy is largely brought about by our artificial and unnatural mode of life, especially by the prevalent custom of eating meat and drinking spirituous liquors." Does the author suppose that, *e.g.*, the Red-skins of North America, the white trappers who

have adopted their habits, or the Guachos of the Pampas,—all of them far more carnivorous than the inhabitants of civilised Europe,—are very liable to suffer from chills and draughts? Or the Fuegians, whose diet consists of little other than animal matter, and who yet, according to Darwin, must be unsurpassed in their power of enduring cold and damp? To continue our quotation:—"For the cure of the evil a vegetarian diet is best adapted, also the drinking plenty of spring water, a liberal use of baths, avoidance of beer and of such clothing and house-heating as tend to keep the body uncomfortably hot." We may here remark that, in England at least, clothing and house-heating which render the body "uncomfortably hot" are rare indeed. But the author continues:—"In addition to this, man should follow the example of the lower animals, only washing and bathing in cold water (temperature about 22° or 20° Réaumur), and taking just so much exercise as will gently stimulate without fatiguing the body." Many of the readers of the learned Doctor's pamphlet in its English version may not be aware that this *cold* water is from 81° to 77° F.! How, we ask, are the lower animals in so-called temperate climes to get water so warm as this? In England the average temperature of the streams and pools will not exceed 50° F. Even amongst men, bathing in water at 77° F. is a luxury open only to the few. Again, we should like to know what proportion of mankind in these days can take "just so much exercise as will gently stimulate without fatiguing"? Multitudes are compelled to take very much more, and multitudes who follow sedentary occupations cannot have nearly enough.

At a loss what to say or think of an author who can gravely advise us to follow the example of the lower animals, by bathing in water at 77° F., we read further:—"There is a prevalent notion that people gain strength by meat diet and spirituous liquors, and make themselves fitter for work, whereas the very reverse is the case. This will appear beyond a doubt if we look at horses and cattle, and compare their strength and 'fulness of life' with their mode of living." This is most lamentable reasoning. A horse or an ox is doubtless stronger than a man, being a very much larger and heavier animal. But neither horse nor ox has anything like the "fulness of life" of a healthy man. Both of them sink much more rapidly under continuous work. Drive, *e.g.*, an ox 40 miles a day for ten or twelve successive days, and note the result. But irrespective of this particular case, the author's mode of reasoning is thoroughly fallacious. Suppose any animal is stronger than man, it does not follow that man would gain in strength by imitating the diet of that animal. What would Dr. Hamernik reply to an anti-vegetarian who should turn his own argument upon him, and say—"This will appear beyond doubt if we look at grizzly bears and tigers, and compare their strength and fulness of life with their mode of living"?

We read further—"That the food taken finally influences the

psychological character is made clear by even superficial observation and comparison of the sheep and the tiger, or the eagle and the dove."

Yes, decidedly by "superficial observation." Whoever will closely study the habits of animals will find that, though vegetarian species do not kill to eat, yet when possessed of sufficient strength and courage they frequently attack, and injure or kill, out of gratuitous malignity. It would be easy to name half-a-dozen species of Herbivora quite as dangerous as any beast of prey.

We regret to find such serious flaws and oversights in Dr. Hamernik's pamphlet, the more as in certain respects he has our sympathies.

Smithsonian Miscellaneous Collections. The Constants of Nature. Part V. A Re-calculation of the Atomic Weights. By F. Wigglesworth Clarke, S.B., Professor of Chemistry and Physics in the University of Cincinnati. Washington: Smithsonian Institution.

Early this year it became our duty ("Journal of Science," 1882, p. 1) to discuss the generality of the principle of Evolution, and in particular the probability of its extension to the chemical elements. In so doing, however, we considered it judicious not to lay any weight upon the law—or rather the hypothesis—of Prout, as not being sufficiently proven. The work before us tells decidedly in favour of that hypothesis, and as such is interesting not alone to the chemist and the physicist.

It may be needful briefly to recapitulate Prout's law. It assumes that, regarding the atomic weight of hydrogen = 1, the atomic weights of all the other elements will be multiples of 1 by some whole number. The bearings of this hypothesis, if demonstrated, are admitted on all hands to be exceedingly momentous. If the elements have existed independently from all eternity, if they have been formed—as the vulgar expression is—"by chance," or if they have been created arbitrarily, the probability of any definite relations existing between their atomic weights, or indeed any other of their properties, is vanishingly small. If, on the other hand, the elements have arisen under the action of some general law, if they mark out the successive stages at which permanence has been gained, we should then consider such relations as the one in question as *à priori* probable. Hence it is but natural that Prout's hypothesis should have been, from its promulgation in 1815 down to the present day, a disputed question. When it first appeared the determinations of the atomic weights, or, as they were then called, equivalents, were in the majority of cases of doubtful accuracy. Hence

whenever exceptions appeared it was argued, not without plausibility, that with greater correctness these anomalies would disappear. This hope did not, however, hold good. Even when Dumas suggested the important modification that the atomic weights of the elements might be multiples of that of hydrogen by halves or quarters, as well as by whole numbers, the discrepancies were numerous, and the hypothesis fell more and more into discredit.

The recent researches of Marignac, and especially those of Stas, which have justly been regarded as models of accuracy, were generally recognised as fatal to Prout's law, since the atomic weights as thus determined agreed neither with whole, half, nor quarter multiples of that of hydrogen, and the variations seem wholly outside the range of experimental errors.

Recently, however, Dumas pointed out a source of error, previously overlooked, in the experiments of Stas. Many of the determinations of the latter chemist had necessitated the use of pure metallic silver, which was melted under a layer of borax and saltpetre. Dumas found that such silver absorbed and retained oxygen in ponderable quantities, thus rendering a correction necessary. On applying this correction Prof. Clarke finds that out of seven elements one has its atomic weight unaffected, one is rendered less accordant with Prout's hypothesis, but five are brought more closely than before to even multiples or half multiples of hydrogen. Thus in five cases out of seven the increased accuracy springing from the correction of Dumas tells in favour of Prout. It is also very possible that other metals, beside silver, when used in the determination of atomic weights, may also occlude gases.

The following argument in favour of Prout is put forward by Prof. Mallet:—Out of eighteen of the elements whose weights are best determined, ten have values which fall within one-tenth of a unit of whole numbers. Now if we examine what is the mathematical probability of such an approximation to the requirements of Prout's law being a mere coincidence, it will be found to be 1 as against 1097·8. In short, if half multiples are considered admissible, it seems more probable that the few apparent exceptions should be due to undetected constant errors than that the great number of close agreements should be accidental.

Prof. Clarke admits that he began his re-calculation of the atomic weights under a strong prejudice against Prout's hypothesis, but that the facts forced him to give it a respectful consideration.

It would of course be rash and premature to pronounce the question decided either way, but, having regard to the evidence collected and arranged by Prof. Clarke, the balance of probability seems to us to be in favour of Prout's hypothesis.

Guide to Practical Work in Elementary Entomology. An Outline for the Use of Students in the Entomological Laboratory of Cornell University. By Prof. J. Henry Comstock. Ithaca, New York: University Press.

The principal object of this little work is one with which we thoroughly sympathise. As a preliminary the author, however, discusses the need of what he calls a more "exact" nomenclature. It seems to him that "the use of the terms upper, lower, inner, outer, before, behind, anterior, posterior, and similar expressions in the technical descriptions of animals and their parts, has led to much ambiguity." A great part of this alleged confusion he ascribes to the fact that "very many of the early naturalists were physicians, and they attempted, in their descriptions of the lower animals, to avail themselves of the same terms that were in use in human anatomy. But as the natural position of man differs from that of the lower animals in being erect, these terms have in one case a different signification from what they do [have] in the other." We must here remark that we have never known a single case of ambiguity arising from this circumstance, nor do we even think it possible. Hence we can see no reason for the "improvements" in nomenclature which Professor Comstock is anxious to introduce. He quotes the dictum of Profs. Wilder and Gage, that biological nomenclature should include "only such terms as are brief, simple, exact, significant, of classical origin, and capable of inflection." The importance of brevity, simplicity, and exactitude we fully recognise; but to "classical origin" we demur, as being fatal to brevity and simplicity, and in many cases to significance. Of its sins against brevity no better instance can be taken than "perissodactylate" used instead of the plain English term "odd-toed." The days are gone by when every student of the natural sciences was a classical scholar. We have now, especially in Entomology, numbers of observers utterly unacquainted with Greek and Latin, and for their sake we demand the minimisation of classical terminology. Indeed, save as far as the names of species are concerned, there is little to be said for the Greek and Latin terms with which the sciences are flooded. International they cannot be called; the Germans, and still more the Dutch, use a technical language mainly of native origin, and intelligible to the people. The French use, indeed, words of classical derivation, but often so distorted that their meaning is by no means readily apparent. Why, then, should the English-speaking nations persevere in multiplying pseudo-classical terms? It seems to us grossly inconsistent to applaud, on the one hand, the foundation of colleges where the natural sciences only are to be taught without classical learning, and at the same time to teach the very same sciences in language which only the classical scholar can

understand! Glossaries may lessen, but do not remove, the difficulty. The more the student is compelled to think of and puzzle himself with the *words* he meets with in his text-books, and the more he must load his memory with their meanings, the more are his time and attention necessarily withdrawn from *things*. Hence, whilst entertaining a high respect for Professor Comstock as an able and learned entomologist, we can only look upon his present pamphlet with profound regret. To us it seems an attempt to lay needless difficulties in the way of the student. What conceivable gain, *e.g.*, can arise from the substitution of the terms "ectal" and "ental" for outside and inside? What brevity, simplicity, exactitude, or significance is won by using "dextral and sinistral" instead of right and left?

The second part of this little work is of a very different character, and if translated into plain English would be an excellent guide to practical work in Entomology.

The Micrographic Dictionary. A Guide to the Examination and Investigation of the Structure and Nature of Microscopic Objects. By J. W. GRIFFITH, M.D., &c., and ARTHUR HENFREY, F.R.S., F.L.S., &c. Fourth Edition. Edited by J. W. GRIFFITH, M.D., &c., assisted by the Rev. M. J. BERKELEY, M.A., F.L.S., and T. RUPERT JONES, F.R.S., F.G.S. London: John Van Voorst. Parts I. to VII. 1881.

THE last edition of this well-known work was issued in 1870. The numerous branches of Science of which this very comprehensive book treats have certainly not stood still during the past eleven years. The microscope itself has been greatly improved, in spite of the opinion expressed some years ago that it had nearly approached all that was theoretically practicable. At the date of the last edition the water immersion system of construction of the objective had not long been known, and only some of the advantages to be gained by its use realised; at the present time the homogeneous immersion glasses suggested by Mr. J. W. Stephenson, and their formula worked out by Prof. Abbe, have done that which was but a short time ago declared to be impossible. With the improvement of the instrument, those branches of Science dependent upon it for the means of investi gation have advanced with proportional rapidity. It is indeed no light task which the editors have undertaken, to revise and add to the edition of 1870.

So far as can be seen, in the few parts at present published, the work appears to be well done. The all-important subject of

bibliography has received great attention, and references are given almost to the date of publication. Taking the article "Angular Aperture," for instance, notice is taken of the diffraction theory of Abbe, which so entirely demonstrates the true function of aperture, although the prominence given to it is hardly so great as is needed for so neglected, but yet important, a subject. References are, however, given to the most recent papers on the subject.

Turning to Coal, the process for softening, by maceration in a solution of carbonate of potash, so that, as it is stated, sections may be cut with a razor, which has appeared in every edition, is still printed: the process has been tried frequently, without the least success. Surely the paragraph should be expunged, or an explanation given if it only refers to some particular kind of coal or lignite.

Many additions have been made to the illustrations, A very beautiful coloured plate of Rock sections, after drawings by Frank Rutley, is very welcome. Petrology is a branch of Science which has made gigantic strides: the microscope and polariscope have here done wonders Doubtless the subject will receive due attention in its proper place in the book.

With so small a portion of the work published it is difficult to know the exact extent of the change contemplated. Some of Tuffen West's beautiful engravings, which formed so prominent a feature in former editions, are still retained. It is to be hoped that a more correct representation of the Proboscis of the Blow-fly than the old one on Plate 33 may subsequently appear: it is correct as far as it goes, being a true representation of the old flattened preparation; but the researches of Lowne and others, on uncompressed specimens, have given more accurate views of its structure.

A good series of cross references is arranged, and will materially help the student in finding the subject he is in search of, and, where space does not admit of so full an account as perhaps might be wished, the ample references to papers where fuller details can be found will supply the want; indeed, with the great variety of subjects contained in the work, no other plan would be possible without making an already large book of unwieldy dimensions. So far as can be seen, the present edition promises to equal, if not surpass, its predecessors.

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*Straggling Magnetic Lights.** By PHILIPP WALBURG KRAMER. Breslau.

WE have in this pamphlet vehement attacks upon medicine as taught and practised by the scientific physicians of the day, and

* Magnetische Streiflichter.

especially upon Prof. Virchow. The author, a professional mesmerist, relates a number of instances in which his treatment has proved signally successful—amongst others in a case of poisoning by phosphorus. Unfortunately he indulges in a violent outburst against physiological experimentation, and thus greatly shakes our faith in his own veracity, as we have generally found that particular monomania known as Anti-Vivisectionism to be accompanied by a tendency to state or to insinuate the thing that is not. Here Kramer tells us that phosphorus is condensed light and a vehicle for the powers of thought and will. The power of healing magnetism is probably connected with a high proportion of phosphorus in the brain. Sensitive patients have asserted that they can smell phosphorus on the author's skull!

A twofold process is constantly active in Nature, spirit being condensed into matter, and matter being again diluted into spirit.

We quote the following singular passage:—"If the famous *savant* Virchow could at last find the long-sought-for bone which bridges over the gulf between gorilla and privy councillor, it would seem to the learned professor that he had reached the very summit of celebrity." We had hoped that by this time everyone must be aware that no Evolutionist authority places privy councillors, or even anti-vivisectionists, on the same ascending line as the gorilla, and that the idea of the "missing link" is consequently about as rational as that of a bone connecting the tips of the thumb and the first finger. Moreover, is Herr Kramer sure that Prof. Virchow is an Evolutionist at all?

What practical power of healing diseases the author may possess we cannot of course pronounce, but his theories seem to us to belong to that anti-scientific movement which is now making itself felt in many countries. A feature of this movement is that persons unqualified by special study come boldly—it might almost be said impudently—forward, and lay down the law on the most difficult questions.

Geological Map of Sutherland. By M. Forster Heddle, M.D., President of the Mineralogical Society. Being No. 21 of the "Mineralogical Magazine." (Messrs. W. and A. K. Johnston.)

We have here a very well executed geological map, on the scale of half an inch to the mile. The contour of the country is well expressed; the heights of the mountains are given, and, in addition to the colouring which indicates the fifteen formations occurring in this interesting county, dips, anticlinals, faults, and

mineral localities are shown by special markings. Archæology has also not been neglected; the sites of old Pictish towers, of castles now destroyed, the localities of battles, &c., are given. The map is pasted on stout cloth, and folds up in a cover of convenient size. It will be an excellent companion for the scientific traveller in the North of Scotland.

The Manual of Colours and Dye-Wares; their Properties, Applications, Valuation, Impurities, and Sophistications. For the Use of Dyers, Printers, Drysalters, Brokers, &c. Second Edition, revised and greatly enlarged. By J. W. Slater. London: Crosby Lockwood, and Co.

The drugs and chemicals now employed in the tinctorial arts have become almost as numerous as those used by medical practitioners. Hence, just as the latter require special treatises on pharmacography and materia medica, so the dyer, the colour-mixer, &c., need the work before us. On the appearance of the first edition, indeed, a pharmaceutical contemporary designated it as a work on "*Materia tinctoria.*" These two words mark out very clearly the position and the scope of the present book. It is no general manual of dyeing or tissue printing. It does not give instructions for the production of this, that, or the other colour upon any given class of materials. Nor, on the other hand, does it explain the manufacture of alizarine or eosine, of red liquor or tin-crystals. It takes up in alphabetical order the several colours, mordants, and other requisites; describes their sources, properties, and uses, the appearance which they should present, the impurities—accidental or intentional—which they may contain, and the simplest means by which such imperfections may be detected. There are also instructions for ascertaining the colours with which any given sample of yarn or cloth may have been dyed or printed. An attempt has been also made to furnish a synonymy of the aniline and other artificial colours, a subject upon which there prevails no little confusion. As the author says, in the tone of one who has himself suffered from the want of system now prevailing, "One and the same substance is sold under different names, and, in return, bodies chemically and practically distinct are confounded under the same name. Not merely inventors and manufacturers give names to new products, but even retail dealers assume the same privilege. Thus we have to deal with a most perplexing chaos." In illustration we find, on examining the work, that there are no ewer than three "xylidine reds," one of which belongs to a

totally distinct class from the other two, and requires a different procedure in its use. The well-known red colour, once in such high request, commonly known as magenta, is called, in strictly scientific circles, rosaniline acetate, whilst among dealers and consumers it often receives such names as roseine, fuchsine, fuschine, fuchsiacine, azaleine, and rubine. "Harmaline" was originally and rightfully a red colour obtained from the seeds of the Syrian rue (*Peganon harmala*), used to some extent as a dye in the East and in Russia. But when the coal-tar colours were first brought out some inventor or patentee appropriated the same name to an aniline violet of the same class as the original "mauve" of Perkin. Others adopted the same misleading principle, and gave to various colours derived from aniline names taken from those of flowers. On the other hand, the strictly scientific names given to the new colours, being for the most part drawn up by German authorities, and embodying theoretical views on the constitution of the compounds in question, are far too long for the use of ordinary mortals. A further source of confusion is, that certain dealers—not perhaps of the highest standing—buy colours from the manufacturer, mix them if practicable, give them a new name, and advertise them as novelties not to be procured elsewhere.

This confusion is not merely a theoretical evil, but a very matter-of-fact nuisance, and though Mr. Slater does not profess to have completely disentangled the web, he has done very much towards it. Henceforth if dyers buy lots of one and the same colour, because offered them under different names, it will be their own fault.

The work contains very much information which may be called original, having never appeared in print prior to the former edition. This matter is generally distinguished by its accuracy and strictly practical character. The subject of mordants was especially treated with a clearness and thoroughness which had never before been equalled, and not a few errors which had found their way into widely circulated books were corrected. Thus it might scarcely be believed that authors on tinctorial subjects were ignorant of the palpable fact that "double muriate of tin" is not a stannic but a stannous chloride. These features have all been retained in the present edition. The additions made are numerous and important, relating of course mainly to dyes and colours introduced into commerce during the last few years. Amongst these figure African red, alizarine blue, alneine, anthracene blue, anthracene orange, anthracene violet, aureosine, benzaurine, beth-a-barra wood, Biebrich scarlet, Blackey blue and orange, benzyl blue, Bordeaux, calliatura wood, campobello yellow, cannelle brown, cauline, chlorozone, chrome alum, chrysoline, coccine, cœruleine, cyanogen purple; the malachite, solid, and methyl greens; enthylrosine pink, eosine and its modifications, galleine, the indophenols and indulines,

laureline, the oranges and tropæolines, rose Bengale, saffrosine, &c. On the other hand, certain dye-wares—which were spoken of at length in the first edition—have passed to such an extent out of use that they now need and receive but scant mention.

The principal omission which we detect is croceine scarlet, a colour which is now coming rapidly to the front, both in wool and cotton dyeing. Bisulphide of carbon has by some oversight been twice mentioned. As a whole, however, this manual carries out in a most satisfactory manner what it undertakes to do. The descriptions of the various dye-wares, &c., are singularly clear and concise, and there is throughout the work a complete absence of that "tall talk" and assumption of omniscience which too often render technological manuals at once unintelligible and repulsive to the busy practical man. The former edition was deservedly a favourite among those best able to judge, and we consider that the work in its present revised form will receive still wider approbation. There is an exceedingly copious index, and the getting up of the book reflects great credit on the publishers.

Records of the Geological Survey of India. Vol. XV., Part 2. 1882.

In an examination of certain Siwalik and Narbada fossils, Mr. R. Lydekker, F.Z.S., concludes that Falconer's subgenera *Hexaprotodon* and *Tetraprotodon* must be abolished, as their distinctive characters are found in the same species. It seems, further, almost certain that it is the second pair of incisors which is suppressed in the African hippopotamus. This circumstance may prove of some importance in determining the homologies of the incisors in other Ungulates—*e.g.*, *Rhinoceros*—in which the whole of the typical series is not developed.

A molar tooth of *Mastodon sivalensis*, from the Punjab, is described as presenting a peculiarity in the arrangement of the enamel not heretofore recognised in the teeth of the *Proboscidia*. The enamel is thrown into a number of folds, placed at regular intervals from each other, which penetrate into the dentine of the cones and converge towards their centres. The horizontal section of one of these cones displays a structure, as regards the depth of the folds of the enamel, intermediate between that of the teeth of *Ichthyosaurus* and *Labyrinthodon*.

Mr. Lydekker gives also a catalogue of Captain Searle's collection of fossils from Perim Island,—not, we presume, the Perim in the Red Sea.

Some ophidian vertebræ from the Siwaliks seem to be identical with those of the still living species, *Python molurus*.

Mr. Ball, F.G.S., contributes an account of the coal-bearing rocks of the upper Rer and Mand Rivers. He is disposed to regard the economic prospects of the district favourably.

Mr. Blanford, F.R.S., gives a full report on the Pench River Coal-field, in the Chindwara district. He pronounces the coal perfectly fit for railway purposes. The general condition of the country is favourable for the establishment of collieries.

Mr. F. R. Mallet, F.G.S., reports on sapphires recently discovered in the north-western Himalaya. The exact locality is not given, but it is in the neighbourhood of Padam, in the Zamskar district, within the territory of Kashmir. Two specimens, sent officially to the office of the Geological Survey for examination, were found to possess the physical and chemical characters of true sapphire. Some specimens contained considerable cavities, enclosing two crystals of tourmaline. The sapphires are found dispersed in a stratum of a white material said to resemble soda. Below this is a blue solid rock. The thicker end of a large broken crystal "looked for about an inch like topaz, the colour being that of deep-coloured sherry, quite transparent," whilst at the other end it was blue, the two colours fading gradually into each other. Practical jewellers inform us that stones are occasionally met with which are sapphire in one part and ruby in the other.

The Field Naturalist and Scientific Student: a Medium of Intercommunication. No. 1. Manchester: Abel Heywood and Son.

It is somewhat remarkable that whilst, with the single exception of elementary manuals, independent scientific works rarely make their appearance, new periodicals on scientific subjects spring up almost as plentifully as new religious sects, with this difference, that they do not find so extensive constituencies. The journal before us approximates somewhat in its character and aims to our old friend "Science Gossip," and contains some interesting matter.

Mr. C. E. Axon contributes a short paper on the "Topographical Distribution of the Nightingale in Britain." Among the counties where this bird is a regular visitor the author omits Bucks, where, in the Aylesbury district, its song is heard every spring. Nor is the fact brought out that the nightingale is more plentiful in the south-east of England than in the south-west. It is very sad that this charming songster is so much exposed to the snares of the bird-merchant and to the guns of brutish idiots.

A F.R.S., in a batch of somewhat singular queries, asks, "Is it as wicked to sell starch for food, and to say that it contains all the elements of food, as it is to put water into milk?" We should say that it is much more wicked, since the watered milk still contains its nutritive elements, though in a reduced proportion, whilst the starch is entirely devoid of albumenoids and fatty matters, and is absolutely incapable of assimilation by young children. But the law of libel throws its shield over quacks of every grade, and until it is mowed down a good many stages it is a hazardous task to look after public health.

"A Manchester Pythagorean" writes on the coming and going of the swallow, and gives the day and month of their arrival, the years not being stated. We should expect the season when they were noticed on April 1st, in so bleak a locality as Barnsley, must have been exceptionally genial.

The Rev. E. M. Geldart communicates a characteristic anecdote of the great naturalist whom we have just lost. Some boys found first a *Dytiscus*, and afterwards some frogs with small fresh-water mussels clinging to their hind legs. They made bold to communicate this observation to Darwin. "In return they received a very kind answer, thanking them for the light they had thrown on a problem which had long puzzled him, viz., How it came about that mussels, which can neither fly nor walk, can migrate from one pond to another."

The Hon. Percy Wyndham, M.P., writes on the sense of locality in animals, a subject on which more extended and more definite observation is needed before we can attempt to theorise.

Memoirs of the Geological Survey of India. Vol. XVI., Part 2. Calcutta: Geological Survey Office. London: Trübner and Co.

THIS part contains an account, by Mr. W. King, B.A., of the Gneiss and Transition Rocks, and other formations of the Nellore portion of the Carnatic. The author, in his general description of the region, remarks that both the soil and the waters of most of the streams, with the notable exception of the Penner, are charged with soda, and are consequently barren.

A curious ethnological fact is mentioned: the Yanadis, a remnant of a decaying race, who inhabit the island of Sriharikota and the waste jungle lands of its neighbourhood, though within an easy distance of Madras, are still in a very primitive condition. "An iron arrow-head is treasured by them as a rare thing; the points of their wooden arrows are hardened by charring, and they are in the habit of obtaining fire by the friction of wood."

The mineral wealth of the district is not great. Schorl has at times been mistaken for coal. Diamonds are said to have been found, but the author has not been able to obtain any trustworthy information as to the exact locality or the supply. There is, however, an *à priori* possibility of their existence in the Penner Gorge. There are beds of iron ore in the southern part of the region, but the metal has never been regularly smelted. There are signs of fairly rich copper ore on the northern side, but the attempts at their utilisation made within the last half century have been costly failures.

The Opium Habit; its Successful Treatment by the Avena Sativa. A Paper read before the New York State Medical Society, February 9th, 1882. By E. H. M. Sell, A.M., M.D., &c. New York: Bermingham and Co.

Admitting for argument's sake—and it is a fairly strong concession—that the "opium habit" is as dreadful as it is pictured by professional philanthropists, and granting likewise that some principle or principles contained in the common oat cure the opium-eater and smoker of their craving for the drug, we do not see why oatmeal porridge or gruel should not simply be used in place of the extract here recommended.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

NOTES ON EXPERIMENTS ON THE ABSORPTION OF DYES BY FLOWERS.

To the Editor of the Journal of Science.

SIR,—With the desire to throw further light on the physiology of plants the following preliminary experiments have been undertaken :—

Solutions were made of the following eleven aniline dyes, viz., alkaline blue, eosine, aniline black, tropeoline and methyl green, magenta, chrysoidine, Bismarck brown, methyl violet, benzyle blue, and malachite green, and a white narcissus placed in each solution. In less than an hour the base of the perianth of the narcissus in the eosine became veined with pink; very shortly afterwards the flower in the methyl green showed veins of colour; next, that in the alkaline blue became veined with blue, while the narcissi in the aniline black and in the tropeoline did not absorb colour until several hours later; but the remaining six aniline dyes—viz., magenta, chrysoidine, Bismarck brown, methyl violet, benzyle blue, and malachite green—were never absorbed at all, although the flowers were left on several occasions a couple of days in the solutions.

It was also observed that the absorption of colouring-matter differed in manner as well as time; thus while eosine invariably coloured the base of the perianth, fading gradually, and leaving the edges of the segments unchanged, alkaline blue always appeared first at the edges of the segments of the perianth, while the base remained wholly, or almost wholly, white. Again, whilst those narcissi in the respective solutions of eosine, alkaline blue, aniline black, and tropeoline became *veined* with colour either at the base or edge, in the case of methyl green the colour spread over the whole surface of the perianth, the venation of the flower not being in any way manifested.

As it was found that the flowers were always consistent with themselves in the manner in which each dye was absorbed, a

narcissus was placed in a mixed solution of eosine and alkaline blue, and the flower then actually performed an analysis, the blue appearing in all its brightness at the edges of the segments of the perianth, and the eosine in unchanged pinkness at its base. This experiment was repeated many times, and always with the same beautiful result.

The experiments having been carried thus far with the anilines, it was determined to try whether absorption would also take place with animal and vegetable colouring-matters.

Solutions were made of indigo and cochineal, the latter in two forms, viz., aqueous solution of the crushed insects, and also ammoniacal solution of *pure* carmine. The indigo was absorbed very slowly, following the venation of the leaves in the manner of the majority of the anilines absorbed: it exhibited, however, one marked peculiarity, viz., that of fading in about twenty-four hours, and not, like the anilines, lasting during the life of the flower. Cochineal was absorbed in both forms, in each case following the venation of the petals; the colour collected at the edges as with alkaline blue, but to a more marked extent, especially in the case of carmine, which in every case gave colour save to the edges of the petals. The solution of carmine was perfectly clear when the flowers were placed in it, but in less than twenty-four hours it became turbid, although the same solution, under the same circumstances, would remain—if flowers were not placed in it—clear for three days.

The dyes experimented with were found to differ not only in time and manner of absorption, but also in a very marked degree in the influence they exercised on the life of the flower,—carmine, cochineal, alkaline blue, and methyl green being apparently quite innocuous, but aniline black and eosine being distinctly injurious, the flowers fading very rapidly after their absorption. This would appear specially curious as regards eosine, for not only is it used in small quantities in confectionery, but rabbits may be fed continually, and will fatten on food highly charged with it. Nevertheless to flowers it would appear poisonous.

Both the single and double narcissi have been used for these experiments (the double narcissi absorb much more rapidly than the single), also the ox-eye daisy, pinks, and sweet pea; and it has been found that not only do the segments of the perianth absorb colour, but also the corona of narcissi, the stem and calyx in peas and pinks, and sometimes also the stamens. Of absorption by the stamens, which occurs less frequently, the white pink is an instance.

If cuts be made partly across the petals, and the flower be then placed in the dye, the colour will pass up by the side of the cut, and then spread in the upper part of the petal over the cut. This is fully shown in the sweet pea, in which flower the veins are completely coloured over the incision; but in the daisy the colour returns by one or two veins only, leaving a white space

over the cut. This experiment is very interesting as showing the nature of the venation of the petals and segments of the perianth, and is an illustration of the similarity of the construction of the petals and perianth.

Of the colouring-matters mentioned above it has been found that none of those which are precipitated by carbonate of soda are absorbed by flowers.

By using white flowers, and placing them in various solutions of dyes, the beauty of the specimens that can be obtained almost surpasses the power of imagination: thus we have a white flower with a delicate green centre; one consisting entirely of the most splendid emerald-green; one delicately veined with pink; another firmly dashed with red through the whole of its petals; and, lastly, one in which the flower has decorated itself by separating from a mixed solution the blue which it judiciously divides from the pink, placing it in a beautiful fringe at the edge of its petals, while carefully reserving the pink as a contrasting uniform tint for the centre of the flower.—I am, &c.,

A. A. Nesbit.

THE SYNTHESIS OF ORGANIC COMPOUNDS.

To the Editor of the Journal of Science.

Sir,—Allow me briefly to remark upon a statement which occurs in a review of Dr. Cleland's "Relation of Brain to Mind," in the May number of the "Journal of Science." The sentence to which I refer is the following:—"It may not be irrelevant to point out that the organic syntheses, of which modern chemistry is so proud, start not from *bona fide* dead matter, but from the remains of what was once living." Here you of course allude to the production in the laboratory of such substances as camphor, the artificial glucosides, the indigo group, and other complex bodies; but the words quoted, if taken literally, may prove misleading to some of your less scientific readers. It is indeed evident that compounds such as the above are subject to the same laws which determine the simplest chemical union, and that no argument can be based upon the apparent impossibility of producing them from their elements. The word "organic," as applied to the chemistry of the carbon-compounds, is universally recognised as a misnomer, in so far as it implies the agency of some peculiar vital force in animal and vegetable organisms, which does not exist in the mineral world. So soon as the paraffins and cyanides were formed from "dead matter," the synthetic preparation of the corresponding alcohols, aldehyds, acids, and

ethers became (as indicated by Berthollet in "La Synthèse Chimique") theoretically possible, and the theory has already been reduced to practice in so many cases that we may probably regard the formation, in like manner, of all remaining "organic" compounds as a mere question of time and patience.—I am, &c.,

CONSTANCE ARDEN.

DIPTEROUS LARVÆ IN HUMAN BODIES.

To the Editor of the Journal of Science.

SIR,—I find it stated, at page 373 of the present volume, that the medical papers give several instances of larvæ, and apparently Dipterous, having been found in human subjects in this country. The subject is one in which I take considerable interest. The only instance with which I am familiar is a case brought before the International Medical Congress, by Dr. Walter G. Smith, of Dublin, who stated that a girl, aged 12, presented herself with the following history:—About three months before being seen by a medical man an ovoid swelling appeared on the outer side of the right ankle, causing her some pain and uneasiness in walking. This swelling gradually shifted its position, and slowly moved up the leg, thence towards the right axilla, then down to the elbow, and finally settled on the back of the neck. In this position a small dark spot appeared, an orifice formed, and, when pressure was made around this opening, a white grub, nearly an inch in length, protruded, and escaped along with some unhealthy pus. Several other similar swellings developed upon subsequent occasions under medical observation, and the medical man extracted other grubs exactly similar to the first specimen. No cause could be assigned for these curious phenomena. The larvæ were pronounced by competent authority to belong to a Dipterous insect, although the genus could not be satisfactorily determined. There was no sufficient proof of the existence of an *Œstrus* peculiar to man alone.

A good abstract, from which the above is quoted, appeared in the "British Medical Journal," October 1st, 1881. I shall feel grateful to any of your readers who will give additional information or references.—I am, &c.,

WILLIAM E. A. AXON.

Fern Bank, Higher Broughton.

THE STUDY OF PRE-HISTORIC MAN.

To the Editor of the Journal of Science.

SIR,—The law of England is fruitful in ways and means for the discouragement of scientific research. With the Anti-Vivisection Act we are all only too well acquainted: the dangers of conducting a *post mortem* examination without a consent which it is not easy to obtain from the ignorant have been recently brought under public notice, and now there appears a third difficulty which is strongly felt by ethnologists and palæontologists. If any human —or I suppose anthropoid—remains are found in the earth, no matter of what apparent age, even if they should be fossilised, the law requires that a coroner's inquest should be held upon them, and that they should then receive "Christian burial." In this manner evidence of priceless value concerning the pre-historic inhabitants of these islands may be withdrawn entirely from scientific examination. If I am not very much mistaken some skulls (if not entire skeletons) in France have been lost. The local Maire—who, sad to say, was a medical man—ordered their re-interment in consecrated ground, and when at last the higher authorities consented to their transfer to a museum it was discovered, or at least alleged, that the place where they had been deposited was forgotten; and thus the specimens have been lost. Surely some alteration of the law is here needful, though it will doubtless be obstinately resisted by the "Anti" party.—I am, &c.,

ARCHÆOLOGIST.

THE PROPAGATION OF SPLENIC FEVER.

To the Editor of The Journal of Science.

SIR,—Certain facts connected with the propagation of "charbon," as it is called in France, seem to have not merely a profound scientific interest, but throw a strong light upon one of the burning questions of the day. The temperature most favourable to the development of this disease is that of mammalian blood, say from 98° to 100° F. Birds, and especially the common fowl, whose blood has a temperature of 107° F., do not contract the disease under ordinary conditions. But M. Pasteur has shown

that if the temperature of a hen is reduced by a prolonged immersion of the feet in cold water, she then becomes susceptible to the disease.

Proceeding in the opposite direction, M. P. Gibier has shown, in a paper lately read before the Academy of Sciences, that cold-blooded animals,—*e.g.*, the frog,—though ordinarily insusceptible, can be rendered liable to the disease by placing them in water of about 95° to 98° F.

Now I should like to ask those "Anti-Vivisectionists" who are neither fanatics nor charlatans seeking to advertise themselves, how the above facts could possibly have been ascertained without experiments on living animals? Unless they are prepared to point out some method they can no longer maintain that Vivisection is useless. If they maintain that the facts are unnecessary, because perhaps not immediately applicable in practical medicine, they place themselves on the very lowest "plane" of purblind Philistinism. Now the value of abstract research is being admitted by manufacturers, are even a minority of medical men about to raise the standard of immediate utility?

FREIBURG IN BREISGAU.

MISTAKEN "INSTINCT."

To the Editor of the Journal of Science.

SIR,—In South Africa horses are passionately fond of the so-called "Caffre corn," and will stray away to great distances to get at a piece of ground where it grows. In small quantities it seems to be perfectly harmless, but if indulged in freely it makes the animals seriously ill, and not unfrequently proves fatal. Is not this a case of mistaken instinct?—I am, &c.,

E. A. S.

NOTES.

Dr. Brown-Séquard ("Comptes Rendus") concludes that no value can be attached to one of the principal bases of the doctrine of psycho-motor centres, and of the generally received theory with regard to the relations between one side of the encephalon and the opposite side of the body for voluntary movements and for unilateral convulsions. It must be admitted that the excito-motor zone of the cerebral surface, as well as all the excitable parts of the encephalon, are capable of setting in movement the members of the corresponding side as well as those of the opposite side. They can produce these effects even after the transverse section of a lateral half of the pons varolii, of the bulb or of the cervical medulla, or even after two sections, the one of the right half and the other of the left half of the base of the encephalon, on condition that a certain interval exists between these two sections.

On May 1st M. de Quatrefages delivered before the Academy of Sciences the formal *éloge* of Charles Darwin. His discourse has seemed to some persons as of "almost inspired eloquence." If we look below the surface we find that the orator was far from rising to the level of the occasion. There is, indeed, no trace of the charge at one time commonly made by the official science of France, that Darwin was a mere amateur. But the speaker defends the Academy with regard to its discreditable rejection of our great naturalist when first proposed as a corresponding member, and actually states that in so doing it "had fulfilled its duties as a scientific tribunal with a high impartiality"! We regret that after this first rejection Darwin honoured the Academy by accepting the subsequent reversal of its former verdict.

According to the "Lancet"—"To the sick, suffering from headache and nervous irritation, the ding-dong and dangle of church bells constitute a very serious annoyance; and we do not hesitate to say, in many cases, the loss of rest and the general disquietude they produce not only lessen the chances of recovery, but may expedite a fatal issue. This is a grave charge, but we make it advisedly."

Taking up the same subject, the "Boston Journal of Chemistry" remarks—"We may add that dogs frequently make night hideous to the well and unendurable to the sick, and the blood of the victim be upon the head of his neighbour who keeps a howling dog. The incessant rattle of a piano is scarcely less annoying to the invalid and convalescent, but sometimes their owners are sufficiently humane to cease the nuisance when asked

to do so; but dog-owners and church sextons rarely possess this virtue, and wise laws should be enacted to protect weak and suffering humanity."

For our opinion on this subject we may refer to the "Journal of Science" for 1880, p. 572.

M. L. Fourment ("Comptes Rendus") proves that salting is not necessarily fatal to Trichinæ embedded in meat; that they may live in salt provisions for fifteen months; and that salting to some extent even withdraws them from the action of heat.

Mr. F. Podmore, B.A., writing in the "Psychological Review," calls attention to the sensitiveness of dogs and horses to ghostly visitations, and considers it "additional proof of the entirely material character, in many instances, of these apparitions."

According to M. R. Kœhler ("Comptes Rendus") crossed fecundations are possible within very wide limits among various species of Echinoidea, differing respectively as much as do two mammals belonging to two adjacent orders. The fecundation is not reciprocal. The ova of *Spatangus* are perfectly fecundated by the spermatozoids of *Psammechinus*, whilst the ova of the latter, if submitted to the male secretion of *Spatangus*, remain intact, or reach at most the blastula stage.

The resignation of Mr. E. Ray Lankester still excites discussion. It seems he would have been required to make formal promise to teach nothing contrary to the "confession of Faith." If so we cannot greatly wonder at his resolution, for how is any man not a theological specialist to know what might or might not be held to be contrary to the said confession?

M. N. E. Sauvage reports to the Academy of Sciences on certain fossil reptiles discovered in the gault of the east of France by MM. L. Pierson and C. Barrois. Amongst other forms is a *Megalosaurus* distinct from *M. Bucklandi*. The distal extremity of the femur of an adult specimen measures 0·470 metre in circumference at the condyles, which points to a prodigious size. A *Pythonomorpha* has also been discovered of the genus *Dacosaurus*.

According io the "Pharmaceutical Journal" potatoes, if unripe or too old, contain a certain quantity of solanine, and may produce serious results if boiled with the skins on, especially if eaten in large quantities.

The British Museum, in its place of exile, will shortly be enriched by the two valuable collections of fossil fishes formed respectively by the Earl of Enniskillen and Sir P. G. Egerton.

According to Arago, Comte had no claims to eminence as a mathematician.

Dr. G. Wylde (" Light ") mentions as a curiosity the presence of Prof. E. Ray Lankester at a meeting of the " Salvation Army," where he seemed like a fish out of water.

We learn that Prof. Tyndall has subscribed £50 to the proposed Carlyle monument. A friend of ours suggests that in so doing the learned professor has, to use an Irishism, " turned his back upon himself."

M. Torcapel, in a communication to the Academy of Sciences, describes a number of mammalian remains found amidst volcanic *débris* at Aubignas, in Ardèche. Among the forms are *Machairodon cultridens*, a large unknown cat, *Hyœnarctos*, a rhinoceros, a *Hipparion*, &c.

The " Medical Press and Circular," in an article in favour of the re-forestation of India, gives facts proving that cholera is far more deadly in the open country than in wooded districts.

The fanatical enemies of physiological research have had a meeting in Edinburgh, and have shamelessly reproduced the statement that vivisection is " scientifically unnecessary."

According to M. Danillo (" Comptes Rendus ") the progress of poisoning by absinthe presents a certain analogy with the effects of strychnine.

MM. Arloing, Cornevin, and Thomas have proved that if a cow is inoculated against anthrax during gestation, her calf obtains immunity against the disease.

MM. Paul Bert aud P. Reynard (" Comptes Rendus ") state that the peroxide of hydrogen, even when very dilute, arrests fermentations due to the development of living beings, and the putrefaction of all substances which do not decompose it. It has no action upon the ferments of the diastase class. In a dilute state it is not destroyed by fatty bodies, starches, soluble ferments, egg-albumen, caseine, the peptones, creatine, creatinine, and urea. It is quickly destroyed by collaginous matters, musculine, blood fibrine, and various nitrogenous vegetable principles.

Two ships' captains have mentioned to M. Knipping (" Ciel et Terre ") an extraordinary oxidation of metals observed at the centre of a typhoon. He asks whether this phenomenon depends on an excessive production of ozone due to the friction of the air on liquid particles?

The new Society for Psychical Research is at work; the first Report of its " Thought-reading Committee " has been made public.

C. G. Massey (" Psychological Review ") defines organism as " the result of force beating down a path for itself.'

According to the "Popular Science Monthly" candidates for professorships in American colleges are almost invariably asked, "What church do you go to?" "What are your views upon such and such doctrines?"

The "Psychological Review" gives a series of ghost-stories, which "M. A., Oxon" guarantees to be the authentic records of actual fact. We regret to find that "Gifford"—one of the interlocutors—is made to drag in a very irrelevant outburst against physiological experimentation.

The "American Journal of Medical Science" maintains that "mesmerism" ought not to serve as an object of amusement, or an aliment for public curiosity, but should be employed solely for scientific objects.

The "Textile Record of America," a weaver's and spinner's organ, has taken up its parable against Evolution!

Mr. F. M. Balfour, F.R.S., has been appointed to the new Professorship of Morphology at Cambridge. It would have been difficult to find a more competent man.

According to Œchsner de Coninck ("Journal de la Soc. Biologique"), β-collidine, a pyridic base derived from cinchonine, is strongly poisonous. If injected subcutaneously, in doses of from 0·05 to 0·15 grm., it occasions general and progressive debility and paralyses the action of the psycho-motor centres. The reflex movements remain intact, save those of the cornea, which are completely abolished. The heart is finally arrested in diastole.

Prof. E. J. Maumené ("Les Mondes") considers that classical chemistry is, in theory at least, nothing but a long tissue of errors.

M. F. Raoult, in a communication to the Academy of Sciences, shows that the lowering of the freezing-point of water, produced by dissolving in it equal proportions of organic substances, follows a well-marked law. If the molecular weight of the substance is multiplied by the reduction of temperature corresponding to 1 grm., the product obtained is approximately constant.

M. C. V. Zenger ("Comptes Rendus") proposes a new combination of objectives for the microscope, by which he obtains a magnifying power of 2000 diameters, with a focal distance of 0·004 to 0·006 metre.

According to H. L. Hermann ("Pflüger's Archiv für Physiologie") seeds germinating in water, or in moist materials, show a perfectly regular and powerful electric current, the roots being negative to the cotyledons. The power often exceeds 1-10th Daniell.

H. T. Fuchs ("Verhandl. K. K. Geolog. Reichsanstalt") shows that the distinction between the littoral and the abysmal faunæ depends not on temperature, but on light. Many abysmal forms are phosphorescent, but not a single littoral species. There are interesting relations between the abysmal forms and the faunæ of caverns.

H. W. P. Wilson ("Flora") finds that in many plants the excretion of carbonic acid decreases at once if a supply of oxygen is excluded. Hence the view that the carbonic acid exhaled by plants has its origin in inter-molecular decompositions, indedendent of the oxygen of the air, is untenable.

Mrs. A. Kingsford, M.D. ("Light") assures the world that she "will scold" on the Vivisection question. Who ever doubted it? A certain "Isabel de Steiger" follows on the same side. We remind these talkative ladies of a truth uttered in the same number of "Light"—"The age of sentiment is not gone, but the age of sentiment without sense will have to go!"

The "Medical Press and Circular" gives an account of a canary, belonging to Dr. J. McGrigor Croft, which, in addition to the usual song of its species, utters a number of sentences with remarkable clearness and precision.

The same paper gives some curious instances of the "commercial instincts" displayed by certain Scotch University professors.

Prof. Bastin ("Proc. Amer. Pharm. Assoc."), whilst botanising with his class at the southern end of Lake Michigan, met with a curious case of atavism in *Cypripedium spectabile*,—a perfectly regular blossom growing on the same stem with one that has the ordinary form. It had three sepals, distinct, and of equal size; it had no lip, but the three nearly equal petals were shaped alike. The ovary was not twisted at all. Prof. Bastin considers that this monstrosity proves that the *Cypripedium* of the present day is derived from a remote ancestral form which was regular, or nearly so.

The "Mineralogical Magazine and Journal" for February mentions, among minerals new to Britain, the following:—Halloysite, found in the Hospital Quarry, Elgin; fibrolite, from the north-west side of Pressendye Hill, Aberdeenshire, and Clashnaree Hill, in Clova; martite, found on the north-west shore of Bute; turgite, in clay slate in the island of Kerrera, in Argyleshire, and to the east of Oban; and Xonaltite, found along with gyrolite near Kilfinnichan, Loch Scredin, Mull.